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- How Linux Is Being Used In Space
- The Google Project Teaching Kids To Code

ARM

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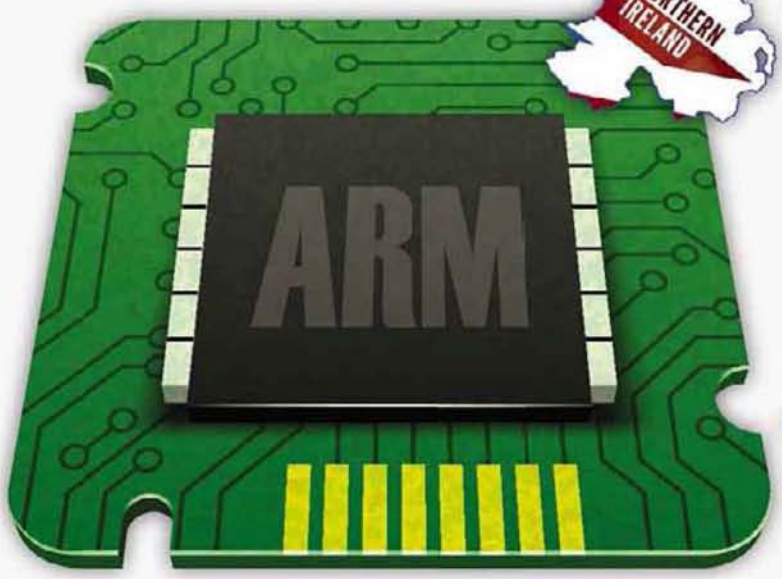

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Based in Cambridge, ARM is without doubt one of the great British successes of modern technology businesses. Now, though, it's accepted a takeover offer from a Japanese company. Will that actually make any difference to how it operates? And how will it affect the phones, tablets and other small devices where its low-power chips are so often found

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Modern PC cases can be enormous things, ready to take on multiple graphics cards, full-size motherboards, several hard drives and coolers that look like the Titanic on steroids. But if your needs are a bit more modest, then a mid-tower could be what you need. We've been looking at a few this week, to get a taste of what's available

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58 Free Up Phone Space

58 Free Up Phone Space

If you've ever found yourself unable to download an app because you've run out of space, then you'll know just how annoying they can be – especially if you can't work out what's taking up all your storage. Rob Leane has some tips to help you clear some room for yourself, and tells you what to do if it doesn't work

60 Project Bloks

The world needs more coders. That's a fact we've known for some time, as we become ever more reliant on computers in our lives. One good way to make this happen is to get children to learn from a young age. Project Bloks, from Google, could well be part of that. Instead of just using software, kids can engage with real physical objects. Roland Waddilove reports

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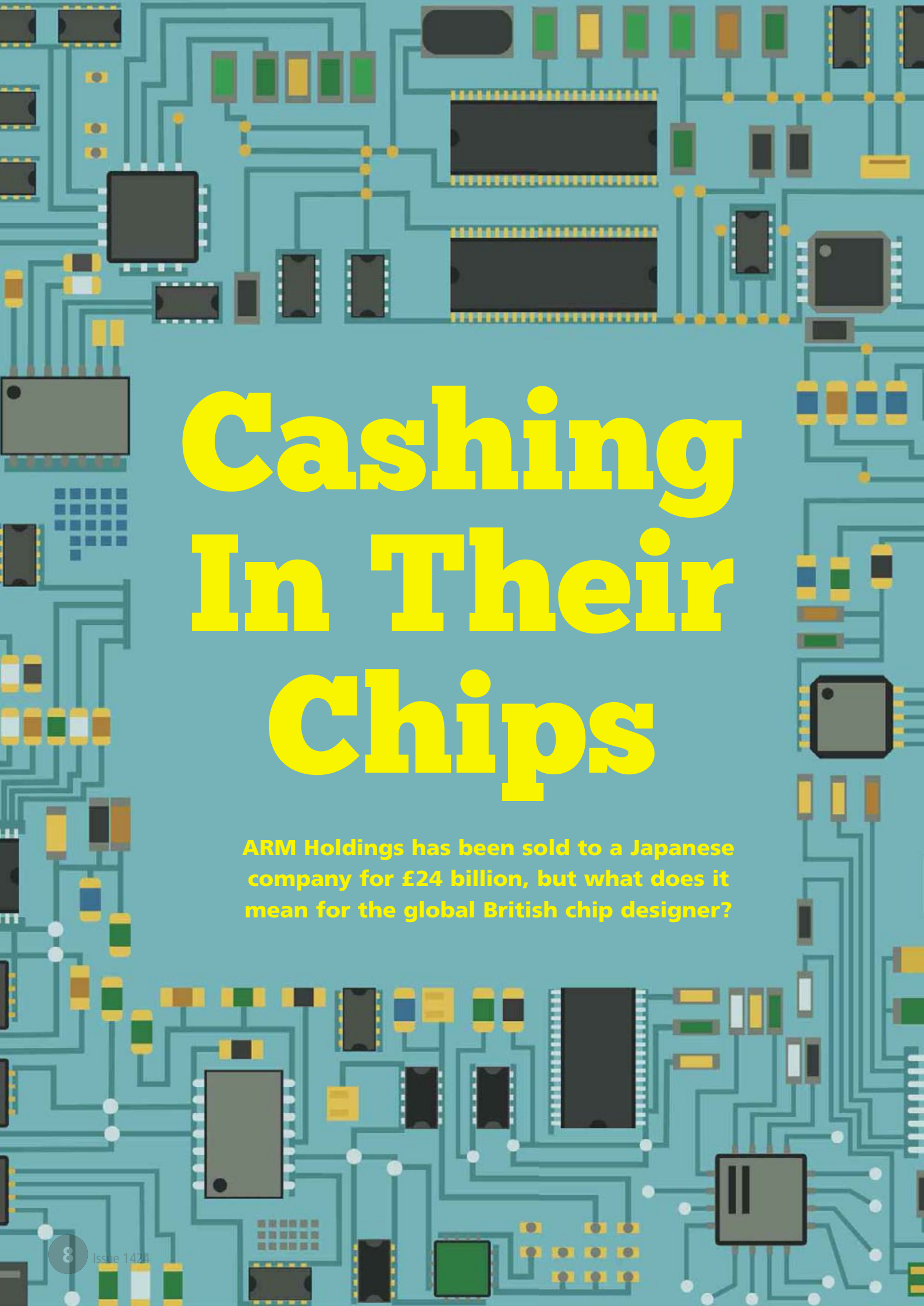


Cashing In Their Chips

ARM Holdings has been sold to a Japanese company for £24 billion, but what does it mean for the global British chip designer?

Open up an iPhone, a Samsung Galaxy or one of dozens of other smartphones from many different manufacturers, and lurking inside will be a processor that uses architecture designed by ARM. Ever since the company was spun out of Acorn in 1990 in a collaboration with Apple, ARM's work has been the beating heart of a ton of digital products, ranging from tablets to digital televisions and the many devices that make up the Internet of Things.

ARM Holdings has grown into a major concern over the past 26 years, employing 3,000 people and operating from large offices in Cambridge and around the world. The chips it designs have been used in Kindle e-readers, Nintendo's 3DS handhelds, Canon cameras and so many other small devices. And yet there's something a little unusual about ARM's operations: it doesn't actually manufacture or sell any of the chips it designs.

> **"I am one of the first people to bet with a big size on the UK after Brexit"**

Instead, ARM licenses its intellectual property to other companies – a business model that has worked so phenomenally well that the firm became the focus of a huge takeover in early summer. Sparked by Masayoshi Son, the chairman and chief executive of the Japanese group SoftBank, it appeared to revolve around two key meetings: the first a dinner with ARM's chief executive, Simon Segars, at the end of June, and the second in Marmaris in Turkey on 2nd July with ARM's holidaying chairman, Stuart Chambers.

By the end of the day, following some back and forth talks, Son had made an enticing offer. He expressed a desire to buy ARM Holdings for a staggering £24.3 billion and, in the process, strike the biggest technology deal Europe has ever seen. It was duly accepted, and with the blessing of both Prime Minster Theresa May and new chancellor Philip Hammond, it was announced to the world on 19th July. "I am one of the first people to bet with a big size on the UK after Brexit," Son said, triumphantly, looking to position the ARM deal as being good for the UK.

And yet almost immediately it led to accusations that the company was being wrestled from British control. ARM co-founder Hermann Hauser tweeted that it was a "sad day", while Steve Furber, who worked at Acorn Computers, later told us, "I can only repeat what Hermann said." Mail Online asked the question "Brexit boost... or sell out?" and it expressed fears of more foreign takeovers. With analysts sharpening their pencils, people continuing to tweet and headlines finely crafted, the deal soon fell sharply into the bucket marked 'controversial'.

ARM

Back To The Future

But why the big fuss? To understand what ARM means not just to the computer chip industry but to the UK as a whole, we have to pay a little visit to the 1980s. It was in the early part of that decade when dissatisfaction at Acorn over the processors being sold by Intel and Motorola led engineer Tudor Brown to look at producing a homegrown alternative.

By kickstarting the Acorn RISC Machine project in October 1983, the computer company eventually produced a 32-bit RISC-based processor, which was unveiled in 1986. It had cost some £5 million to get to this point, and it had seen Acorn become a subsidiary of Olivetti in the process, but the processor was widely applauded and proved the credentials of those behind it.

The processor found its first commercial use in the £4,500 ARM Development System for the BBC Master in 1986, but its inclusion within the Acorn Archimedes computer released in 1987 was of far greater importance. The Archimedes not only

How ARM Helped Make A Legend

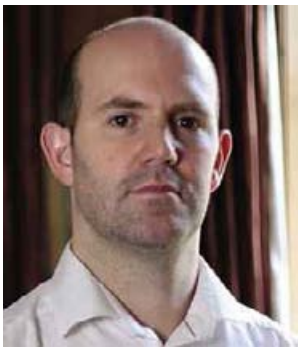
ARM cores have been used in all Raspberry Pis since the inception of the much-celebrated micro-computer. We caught up with the CEO of Raspberry Pi (Trading), Eben Upton.

Micro Mart: Were you surprised at the news?
Eben Upton: Absolutely. Although it's a commercial company, I think we've all become very used to thinking of ARM as a piece of community infrastructure: it's surprising when you're reminded it can be bought and sold like any other business.

MM: What are your hopes for the deal?
EU: I hope (and we've already been assured) that this will be business as usual for ARM, and that we won't see any changes to its basic way of doing business.

MM: What made ARM so special and to what degree is its Britishness important?
EU: ARM has combined great technology with an innovative and surprisingly modest business model, taking a small slice of revenue from a large number of units. This has given them incredible reach.

MM: How has ARM helped the Pi?
EU: A couple of things. First, and most straightforwardly, we've used ARM cores in three generations of Raspberry Pi product, and have benefited from the vast amount of work that has been put in by ARM and the wider community it has nurtured to make software like the Linux kernel and gcc work well on the platform. Second, our business model is strongly inspired by ARM: we design the Raspberry Pi and maintain the community around it, relying on our licensees to actually build the product in much the same way that ARM does with its licensees.



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▲ *How the Financial Times reported the news of SoftBank's takeover of ARM*

became the first RISC-based home computer; it found its way into many UK schools as an alternative to PCs, and allowed Acorn to consolidate its position in the educational market.

The chip also caught the eye of Apple, which was interested in the expertise being built at Acorn. The US firm has decided Acorn would be a good talent base to tap into during the building of its first personal digital assistant, the Apple Newton and, as it turned out, it became a major turning point in the history of computing in more ways than one.

Larry Tesler, the vice president of the Personal Interactive Electronics division at Apple, had encouraged Acorn to collaborate, and the result was the formation of ARM Holdings in 1990. Comprised of 12 former Acorn engineers and headed up by Sir Robin Saxy, Apple and Olivetti both took a 47% share in the company, and Hermann Hauser took the rest. The idea was to license chip design to other firms and for those to deal with the manufacturing.

ARM soon showed its worth. Former Apple CEO John Scully would later reflect, "While the Newton was not commercially successful (it was too early for its time), the ARM processor became the core of every mobile device that's sold even today." Perseverance and talent had won out in the end, and ARM began to develop an expertise for designing elegant, low-powered chips.

What They Said

"ARM is the proudest achievement of my life. The proposed sale to SoftBank is a sad day for me and for technology in Britain."
Hermann Hauser, co-founder of ARM

"The purchase of ARM is a bet by SoftBank that computing power an connectivity will be embedded into almost every physical object in the world."
The Guardian editorial

"This is good news for British workers, good news for the British economy. It shows – as the Prime Minister has been saying – that we can make a success of leaving the EU."
Spokeswoman for Prime Minister Theresa May

"Brilliant UK-based companies like Deepmind and ARM being bought by foreign owners means British ingenuity is contributing to other countries' tax revenues."
Tom Cheshire, technology correspondent, Sky News

"I'm worried about this for a whole set of reasons. I think this is the last of the home-grown British hi-tech companies that survived."
Vince Cable, former business secretary

"Japan's Softbank investing £24 billion in Cambridge-based firm. Cheaper pound good for foreign direct investment."
Nigel Farage, former UKIP leader

"If the government simply waves through a stream of opportunistic takeovers of our great companies while sterling is on the floor, our capacity to ever again pay our way in the world will be fatally holed."
Robert Peston, political editor, ITV News

"This is a company I always admired for the last 10 years. This is the company I wanted to make part of Softbank. I am so happy."
Masayoshi Son, chairman and chief executive of SoftBank

"To be fair, SoftBank seems to have been a very good owner of France's Alderbaran, upping its profile – promises same for ARM."
Rory Cellan-Jones, technology correspondent, BBC News

"SoftBank has given assurances it will invest considerable in the business, including doubling UK headcount."
Stuart Chambers, ARM chairman

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One of ARMs' global offices in Cambridge, as seen in Google Street View

This saw it become incredibly attractive to companies looking to produce mobile devices. Nokia's decision to use ARM technology as it forged its way into the mobile market brought untold riches to ARM, and the company was eventually floated on the stock market in 1998. Apple had sold its share for $800m by this point to prevent itself from going under, but the chip-designer would go on to play a major part in the future of tech – including that of its co-founder.

Indeed, ARM was instrumental in Apple's second rise to dominance, not least through the use of ARM technology in the iPod and, in turn, the iPhone and iPad. Since then, it has ended up powering more than 95% of the mobile market and, more recently, it has been designing chips that are perfect for internet-connected devices ranging from fridges to cars. Given its potential, SoftBank's decision to pay £17 for each ARM share, and its willingness to pay a premium of 43% on its closing price the week before may well appear to be a bargain.

Top Value

How much of a good deal this represents quickly becomes apparent to any company that tries to enter the mobile market. ARM may not make any products itself but the information and knowledge that it has built up through huge amounts of time and money spent on research and development has proven vital. It is always cheaper and quicker for major manufacturers to buy a licence from ARM than it is to build their own infrastructure and R&D departments from scratch. With more than 4,500 patents either granted or waiting to be rubber stamped, going against it is more hassle than it is ultimately worth.

So what does ARM get out of it? The company takes a tiny percentage royalty from every chip that is sold, and that soon builds up into mammoth sums, given the amazing amount of tech being shipped. The company has, from time-to-time, considered getting its hands dirty in making devices rather than relying entirely on the licence and royalty fees, but the idea has always been dismissed up to now because the current model works so well. It has won ARM many friends, with customers ranging from Microsoft to Qualcomm to Nvidia.

But what will SoftBank do with the company? On the face of it, everything appears rosy. SoftBank has promised to double the number of UK staff working in Cambridge, and it also says it will hold onto the existing management at ARM. Son insists that the company will remain in the UK and that SoftBank is committed to investing in Britain. All of this makes sense: in a company built on ideas, retaining the brains that come up with ARM's lucrative intellectual property should be a given.

Chancellor Of The Exchequer Philip Hammond's Statement In Full

"This £24 billion investment would be the largest ever from Asia into the UK. It would guarantee to double the number of jobs in ARM in the UK over the next five years and turn this great British company into a global phenomenon. Just three weeks after the referendum decision, it shows that Britain has lost none of its allure to international investors. Britain is open for business – and open to foreign investment.

"Softbank's decision confirms that Britain remains one of the most attractive destinations globally for investors to create jobs and wealth. And as ARM's founders will testify, this is the greatest place in the world to start and grow a technology business."

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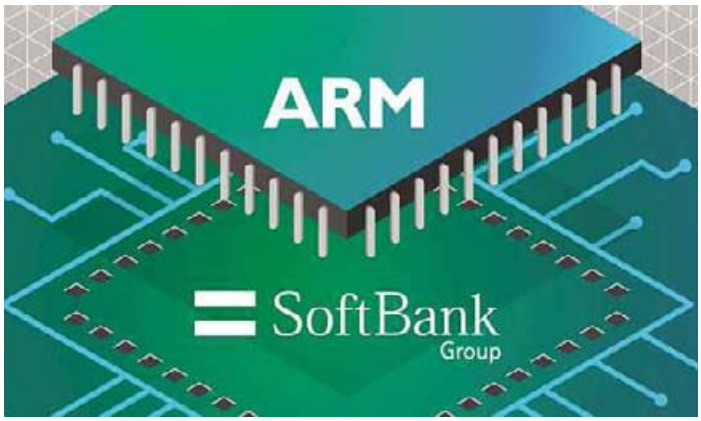


The deal was announced to the world on Monday 19th July

ARM has been going from strength to strength on the back of the workers' talent. The company has generated a 14% rise in pre-tax profits, which has allowed it to take in £137.5m in the first quarter. It has also seen revenues jump 22% to £276.4m. The number of chips containing ARM-designed processors rose from 2.5 billion 10 years ago to 7.90 billion five years ago to 12 billion in 2014 and 14.8 billion in 2015. And yet you sense, on an investment of £24bn, that those revenues need to be even higher.

The impression is that SoftBank – with its $100bn debt – will have wanted ARM as much for its future potential as for what it's doing in the here and now. It has struck at a time when the post-Brexit pound is 23% down against the Japanese yen since the start of the year, making it the most inexpensive of moments to buy. But just where does ARM fit into SoftBank's portfolio? After all, SoftBank is a multinational telecommunications and internet corporation, which deals with broadband, the internet, e-commerce, finance and fixed-line telecommunications. Only now has it got into the realm of chip design.

> **"ARM has more than 4,500 patents either granted or waiting to be rubber-stamped"**

Analysts are suggesting that the company has a vision of a telecommunications and computing industry that is steeped in the Internet of Things, robots and artificial intelligence, and that SoftBank wants to get in now while the economic climate is favourable and while there's a chance of seeing off rivals.

This would appear to be backed up by Son himself: "ARM will be an excellent strategic fit within the SoftBank group as we invest to capture the very significant opportunities provided by the Internet of Things. This is one of the most important acquisitions we have ever made."

But the Internet of Things is likely to be a medium-term trend, and if SoftBank wants a quicker return on its investment, then it may look to diversify too. An interesting school of thought is that SoftBank will look to become a fabless semiconductor company in the same vein as Qualcomm: that is, finally going into the business of selling and making chips based on its design albeit in a factory owned by another company. Qualcomm's market value exceeds $100 billion, which gives a good indication of the potential of going down such a path. It could so easily work.

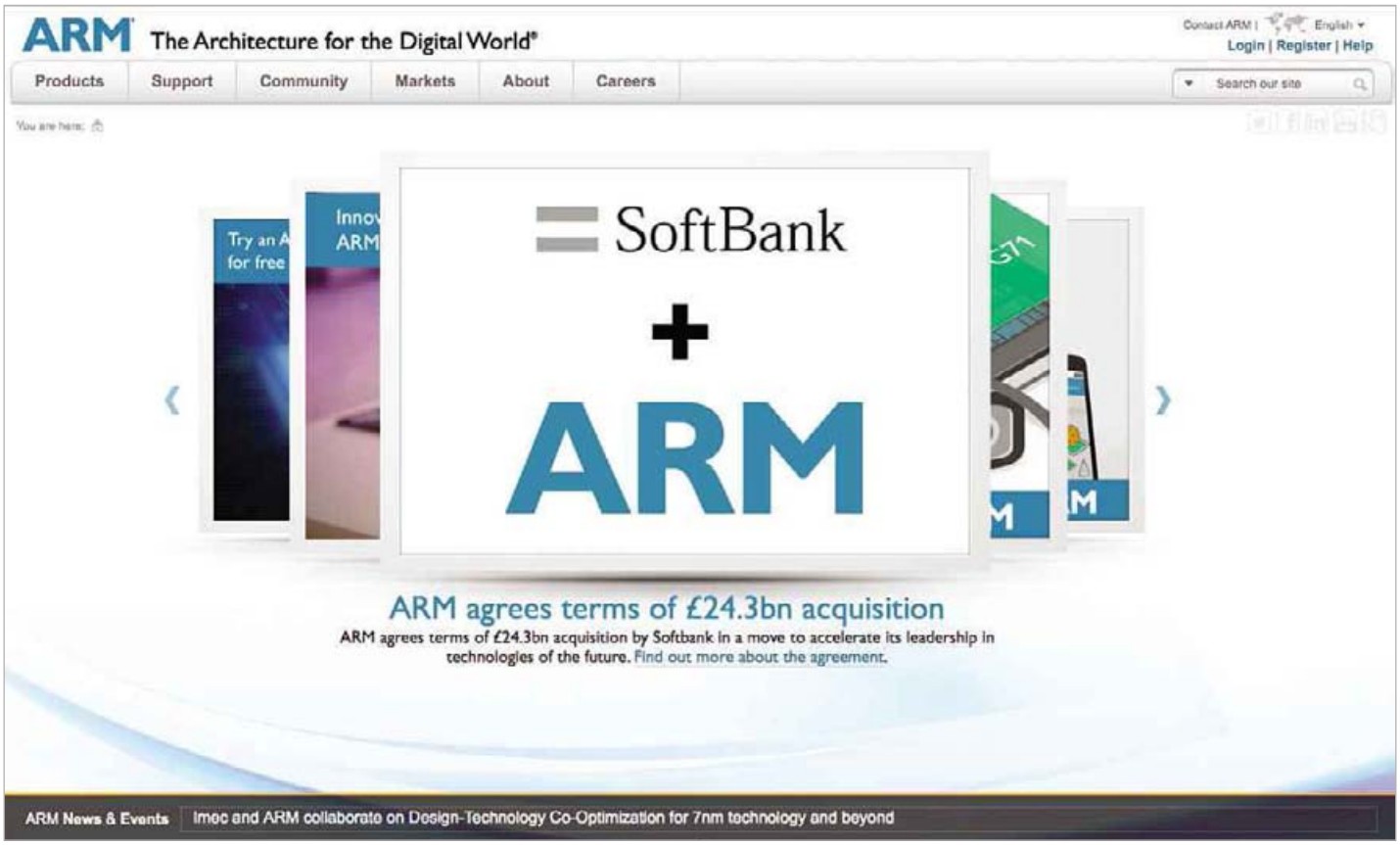
Political Fallout

One thing the politicians will be keen to do, though, is to keep Son to his promise of retaining ARM in the UK. In welcoming the deal, the Prime Minister has already managed to perform a U-turn just a week after her speech in Birmingham, in which she said her plan was to oppose foreign takeovers of British business.

It would mean the fallout from any move abroad or axing of staff would be very damaging given the sensitive years that lay ahead. In speaking to Son and congratulating him, the pressure

ARM Timeline

1985: The world's first commercial RISC processor is developed by Acorn.
1987: Acorn's ARM processor debuts – a 32-bit CPU running at 8MHz.
1990: Advanced RISC Machines is founded as a spin-off from Acorn in a joint venture with Apple and VLSI Technology..
1991: ARM introduces its first embeddable RISC core: ARM6.
1993: The company introduces the ARM7 core.
1995: ARM releases the Thumb instruction set, which gave 32-bit RISC performance. One of the first devices to use it is the Game Boy Advance.
1998: ARM Holdings is floated on LSE and NASDAQ.
1999: It joins the FTSE 100 Index.
2001: ARM's share of the 32-bit embedded RISC microprocessor market grows to 76.8%.
2001: New ARMv6 architecture is announced.
2002: More than a billion of its microprocessor cores had been shipped at this point.
2002: The ARM11 microarchitecture launches.
2004: ARM announces the Cortex family of processors, which are based on the ARMv7 architecture.
2004: The ARM Cortex-M3 processor is announced.
2007: A landmark moment with five billion ARM-powered processors shipped to the mobile industry.
2007: The ARM Cortex-M1 processor is launched, becoming the first ARM processor designed specifically for implementation on Field-programmable gate arrays (FPGAs).
2008: The 10 billionth processor shipment is announced.
2009: A 2GHz capable Cortex-A9 dual-core processor is revealed.
2010: The Cortex-M4 processor launches, allowing for high-performance digital signal control.
2011: Microsoft unveils Windows on ARM.
2012: The first UK forum to create technology blueprint 'Internet of Things' devices is formed by ARM.
2012: Raspberry Pi is unveiled, with its ARM CPU.
2013: More than 50 billion chips have been shipped.
2015: New ARMv8-M architecture is launched.
2015: The BBC:microbit aims to educate UK school children into coding and is launched in partnership with ARM.
2016: A 4K-capable ARM Mali-DP650 display processor is unveiled.
2016: SoftBank takeover hits the headlines, dividing opinion.



is on, especially given that the deal raised eyebrows among many who believe the company to be a jewel in Britain's tech crown and that ARM should be the one doing the takeovers of foreign companies, not the other way around.

But with rising controversy, Segars sought to calm fears. "We are not expecting SoftBank to come in here and say this is the way we do business, and here are a lot of processes you have to follow," he told the Independent. "They look at us and they see we are running a successful, profitable business. The thesis behind this is the two of us working together to drive the technology forward."

> **"We are not expecting SoftBank to come in here and say this is the way we do business"**

The markets seem to think it will work. Shares in ARM Holdings rose 41% on the news, and London stocks also closed higher. The takeover had a direct effect on other tech and communication companies: chip designer Imagination Technologies Group rose 10%, and there was talk of firms potentially looking at the likes of TalkTalk as potential takeover targets. Yet SoftBank's own shares fell by more than 10% as many looked to sell. There are never any certainties in any deal.

Everyone seems to agree that SoftBank has bought well, though. Although the expressions of joy among some politicians would have you thinking ARM was a recent startup-done-good, it has managed to take over one of the longest-running and most respected tech companies in the world. It's the global chip leader that has grown from a little Acorn – and one that we hope will stay rooted in the UK for decades to come. **mm**

Who Is ARM Chairman Stuart Chambers?

Stuart Chambers joined ARM Holdings on 27th January 2014, becoming chairman on 1st March that year. Since then, the 60-year-old has seen ARM named one of Britain's top employers and ranked third in Forbes' list of the most innovative companies in the world. It has worked with the BBC on the micro:bit, continued to release new architecture, partnered with UNICEF and worked on the deal to sell the company to SoftBank.

But it's not the first time Chambers has worked for a Japanese company. He was chief executive of UK-based Pilkington Glass, which was acquired by the Nippon Sheet Glass Group in 2006, and he went on to become the Japanese firm's group chief executive – one of a few foreigners to head up a Japanese company.

Yet he stepped down from the role in 2009, saying he had decided to put his family first. He also admitted that his decision went against Japan's social norms, which tends to place a company in the number one position in life. "In that process, I have learned I am not Japanese," he said. He went on to become a director at Tesco, chairman of Rexam and a non-executive director of The Manchester Airport Group among others, his business acumen very much in demand.

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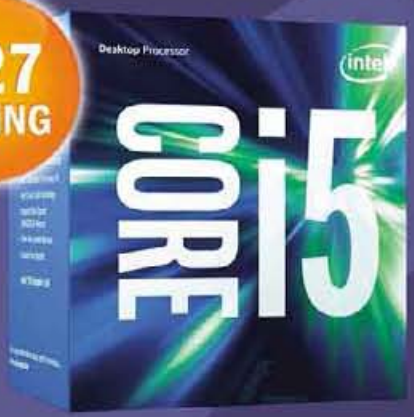

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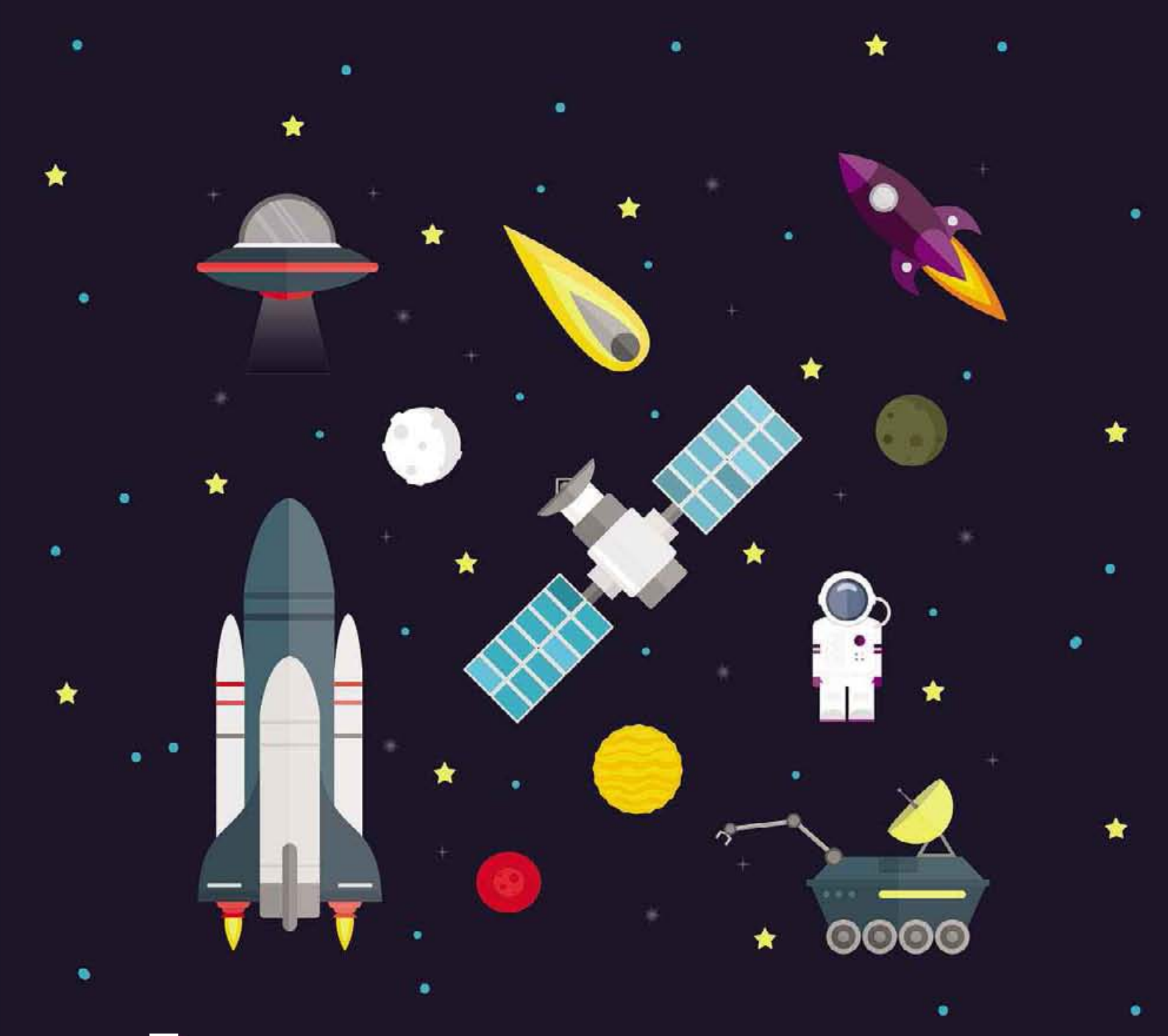


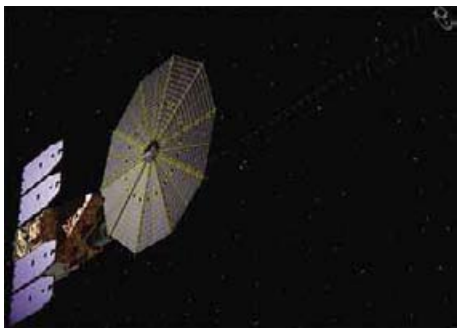
Linux In Space

One small step for Micro Mart, one giant leap for the kernel

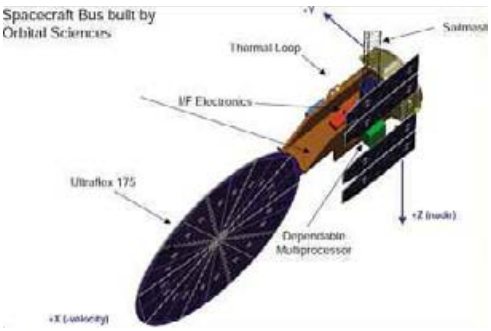
The Linux kernel certainly is a versatile beast. It not only performs magnificently on our desktops, but it's also used daily on any number of mobile devices and in server rooms around the world. However, what you may not know is that Linux is used regularly in another environment, quite different from the home, office or machine room: yes, Linux can be found in the inky abyss known as space.

It may seem a little sci-fi, and the temptation to use a quote from the legendary Captain Kirk is overwhelming, but what has been happening over the last decade or so, in the space and aeronautics industry, is a shift from conventional operating systems or on-chip custom-built systems to a flavour of Linux.

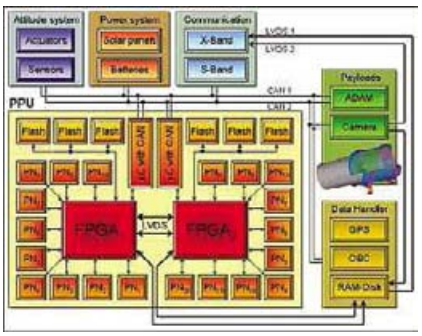
Why this shift? There are several explanations, with money the top of the list. After all, why bother spending astronomical amounts of cash on product licensing or hiring teams of embedded systems solutions developers when Linux is available at a



The ST8 SpaceBus would herald in a new era of payload transport



The Star Ship Enterprise. No, sorry, the ST8 SpaceBus



The CPU PPU Linux Beowulf cluster diagram used in X-Sat

fraction of the cost and the accompanying Linux devs come as a cheaper solution.

Another reason why Linux has fast become the OS of choice for the space industry is simply down to good old-fashioned processing. Apparently, to be a successful space operating system requires the use of advanced algorithms, pre-emptive scheduling and a more critical interrogation of memory allocation. Collectively this is known as a real-time operating system.

A real-time OS is capable of guaranteeing the timing requirements of the processes under its control, so rather than being designed for maximum throughput, as our standard desktop systems are, these RTOSs are developed to improve the correct timing of events. Naturally, the Linux kernel is a free resource that is more capable of being customised and modified than any other OS available, to eventually become a fully functional RTOS, although in fairness it does take some stripping down on the kernel before it's ready to be used as a true RTOS.

Linux has many advantages for the space industry, so over the next few pages we're going to have a little look at what space programs are currently using Linux and what future projects will involve our favourite OS as it boldly goes where no OS has gone before.

ST8

The Nasa New Millennium Program, Space Technology 8 (ST8) may have run into some problems with the sudden cut in budgets a while back, but one particular technology within this project is still ongoing and still receiving its fair share of funding.

That project is the Dependable Multiprocessor (DM), being developed by Honeywell's Aerospace division and Wind River (an embedded Linux vendor). The idea is to build space-based computer systems that are up to one thousand times more capable than the space-borne systems that are running currently.

By using commercial off-the-shelf (COTS) based systems, the aim is to have a system that will be able to withstand the harsh and extreme conditions of space while processing terabytes of data per day in the most power efficient way possible.

Space, being a not very nice place to hang out, represents a variety of problems to equipment. What works quite happily down here on Earth will inevitably fail in space, mainly due to the effects of radiation, which we on Earth are protected from by our atmosphere. So Honeywell and Wind River are using an undisclosed Linux OS layer, with some clever custom developed Linux middleware, to create a semi-automated system that is capable of analysing itself, looking for radiation in the form of charged particles and checking its systems for any radiation-induced errors.

> **"The Linux kernel is a free resource that is more capable of being customised and modified than any other OS"**

On top of this are the usual lab-based functions that an orbital or deep spacecraft have to perform. These are usually run from a sandbox environment on Earth, then transmitted to the craft's systems as a job, but the new DM system's Linux-based software will hopefully be able to process and analyse its own data to make any decisions as to what needs to be observed or not, without having to contact Earth and wait for a reply.

Dr John Samson, principal engineer at Honeywell, commented in June 2007, "As space missions continue to become more complex and demanding, it is critical that the on-board computing equipment is built to handle the intense data processing and analysis that is required. As a result of the

X-Sat preparing for launch

The payload for the X-Sat, the box on the left

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demonstration of COTS (commercial off-the-shelf) in the ST8 flight experiment, the application of Dependable Multiprocessor technology is expected to yield unparalleled benefits for years to come, particularly in the reduction of development time, cost and risk of future space systems."

It's all rather clever, and although it's not quite on the fully autonomous level of HAL 9000, thankfully, it does represent a significant leap forward in on-board science data processing, together with a computer system that is capable of making its own decisions and acting accordingly based on the information it receives.

Space Bus

Another exciting Linux-based project, one that was born from the above ST8, was the ST8 SpaceBus. 'Was' being the operative word, because unfortunately it was cancelled, again due to monetary restrictions and space exploration budget cuts, but the design and systems are destined for future missions.

The SpaceBus is a lightweight, multi-role spacecraft based on the Orbital MicroStarT platform used for space-based science missions. The system that would have controlled and interfaced with the ST8 payload modules, as well as operated as an OS for the networking equipment and the vital subsystems that control the craft, is Wind River's Linux Edition platform.

Plus, if you rotate the image slightly, it also bears a striking resemblance to the Starship Enterprise.

Beowulf In Space?

As many of you already no doubt know, by Beowulf, we are referring to the term coined by Nasa engineers Thomas Sterling and Donald Becker for a cluster of computers, and not the bearded Scandinavian lunatic who has a tendency to rip the arms off demons.

A Beowulf cluster is, for all intents and purposes, a cluster of identical networked computers that use a variety of applications, which allow the processing to be shared across the resources of each computer collectively in a high-performance parallel computing cluster using only basic PCs.

The task of setting up a cluster itself is fairly easy; you can even try it at home if you have a couple of spare machines. There are many uses for this type of computing, one of which

UoSAT-12 preparing to undergo flight checks before lift-off

UoSAT-12 was a pretty impressive piece of British ingenuity and technology

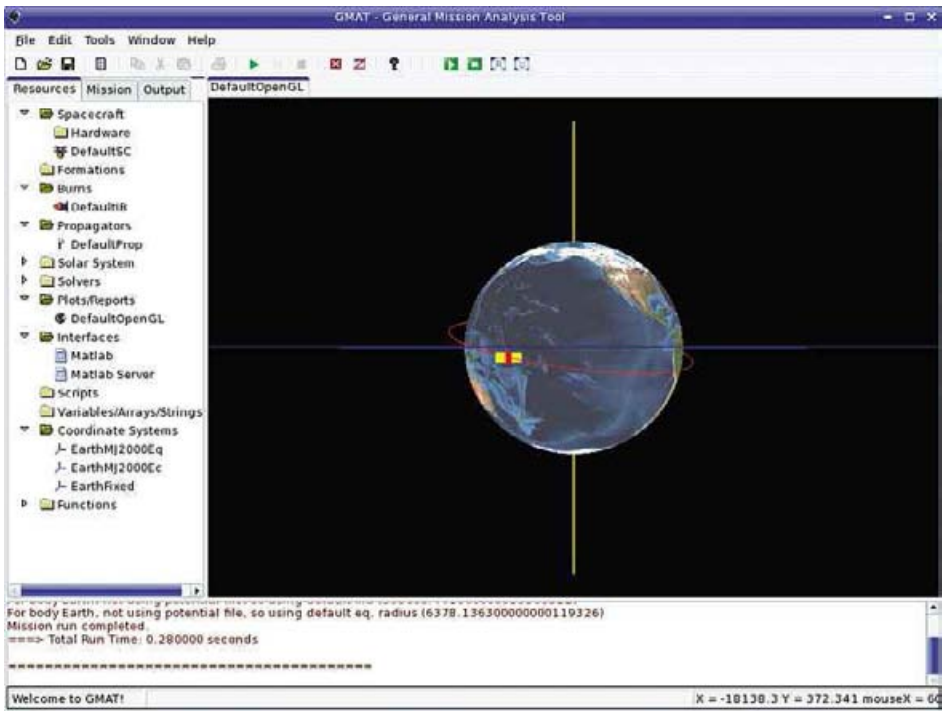
was executed to solve a bandwidth problem on the micro satellite X-Sat.

X-Sat is a joint venture of CREST (Centre for Research in Satellite Technologies), NTU (Nanyang Technological University) and the Singapore National Laboratories. Its primary function is Earth observation and imaging, monitoring sea levels, forest fires, population expansion and other environmental aspects. To do so, it houses an impressive high-definition camera that can take incredibly detailed images and transmit them to the processing station in Singapore.

It has two computing units on board: an OBC (on-board computer) that takes care of the telemetry, payload, communications and other satellite functions, which runs the RTOS Linux VxWorks; and a PPU (parallel processing unit), which is a Beowulf cluster of 20 206MHz StrongARM CPUs that run a modified 2.4.4 Linux kernel.

The cluster was built to help process the 80GB-plus of data that X-Sat generates over the course of a single day, but what's important here is the fact that the satellite can only communicate with Singapore for a few minutes every orbit, so a lot of data has to be transferred in a short time.

The cluster's main task is to process the collected data and only send those images



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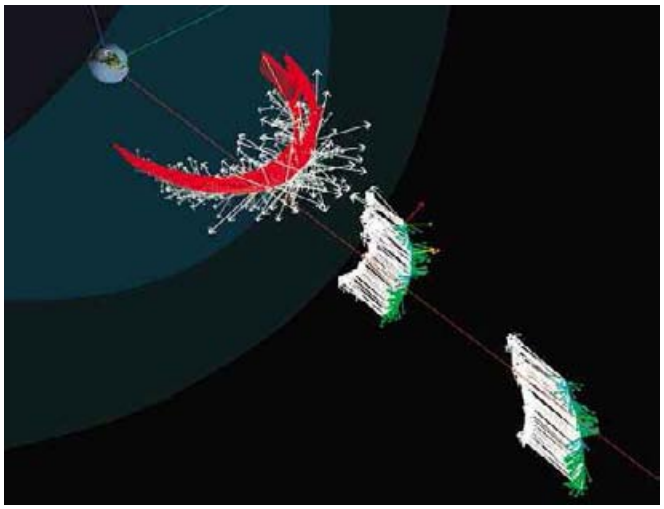
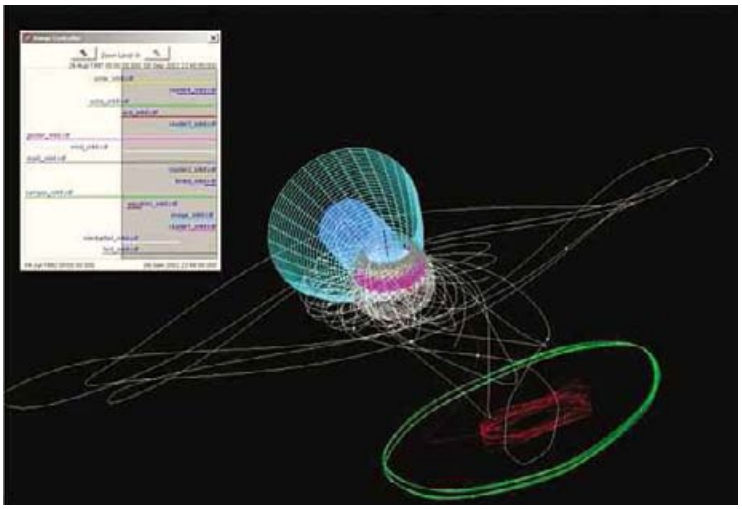


ViSBARD takes complex vector data and turns it into a slightly less complex image



Look what happens when you leave the spacecraft in the control of a Micro Mart writer

that are of value to the mission, as it flies over Singapore at an altitude of roughly 500 miles. Think of it as an orbital media server.

Nasa's Omni Project

In terms of communications, surprisingly, the space program is way behind anything that we have here on Earth.

Just from our own humble desktops we can browse the internet, email friends and family, conduct video chat and play the latest games, all via our high-powered bandwidth connections. But to those who work on the International Space Station, this is a luxury they can't afford.

Most communications between the space shuttle or the ISS are conducted in a closed point-to-point fashion, using conventional and fairly old-style technologies, but what if spacecraft are capable of accessing the internet?

Nasa's Omni Project (Operating Missions as a Node on the Internet), based out of Nasa's Goddard Space Flight Centre, has been working since 1998 to place a series of IP-enabled nodes on various satellites and the ISS, using some very basic processing power.

For example, the ill-fated Shuttle Columbia was fitted with a 233MHz ARM CPU, 128MB RAM and 144MB SSD, with Red Hat Linux 6.1 installed, which successfully maintained contact, using IP to essentially turn the shuttle into a node on the internet (a setup Nasa mirrored on the ISS), with ground control.

As Omni project manager Jim Rash said in 2008, "Imagine if the spacecraft were network-enabled. They can be designed to talk to each other, share data and alert each other to things that they have noticed from their own sensors."

But the Nasa Linux IP in space initiative all started with a British-built satellite: UoSAT-12. This micro satellite was designed and built by Surrey Satellite Technology Ltd, an aerospace company that was a branch of the University of Surrey.

Launched way back in 1999, it had all the necessary components: COTS equipment and an IP-stack-enabled Linux kernel to allow the IP instructions to be uploaded. And in May 2000, UoSAT-12 became the first orbiting IP address with an experimental 1Mbps downlink communication to ground control.

Shortly after, UoSAT-12 was pingable, it could synchronise its time from an NTP (tick.usno.navy.mil), and a successful FTP transfer was conducted. In January 2001, UoSAT-12 became the first orbital web server.

Unfortunately, it no longer has an IP address or hosts a web server for that matter, but it's still up there, and if you head to **www.n2yo.com/?s=25693**, there's a real-time Google map of the current location of this ground-breaking Linux satellite.

Nasa Open Source Portal

While the systems and operations may be out of the scope of us 'normal' folk, we can have a little bit of Nasa on our very own humble desktops. The Nasa Open Source Portal (**open.nasa.gov**) is a website that embraces the key elements of the Open Government Plan: transparency, participation and collaboration.

William Eshag said in 2012, when the site was first launched, "We believe that tomorrow's space and science systems will be built in the open and that code.nasa.gov will play a big part in getting us there. Will your code someday escape our solar system or land on an alien planet? We're working to make it happen, and with your help, it will."

So far the Open.Nasa portal appears to be a worthy success that utilises the talents of the general public for the ultimate greater public good, as Nasa's work includes the issues that affect us in general – climate

Linux Space-based Providers

Thinking of turning your Linux developing skills into the space industry? Well then, here are some links to sites that we have nailed down as Linux providers to the space and aeronautics industry. All you have to do is send them your CV, perhaps with a nice Nasa open-source reference in there? And who knows, maybe you'll be the one who develops the first Linux on Mars:

- QinetiQ (**goo.gl/hrwEh8**): Hardware and software expert, used in many environments, of which space is one.
- ETH Zurich (**goo.gl/S6pOyj**): Expert in payload software and hardware for global observation systems.
- Lynx Software Technologies (**goo.gl/FDIQDq**): Major provider of RTOS Linux systems, used in ground control and other high availability systems.
- Wind River (**goo.gl/AnuP8J**): The big daddy of Linux RTOS systems for the space industry and of the biggest Linux development companies in the world.
- Terma (**goo.gl/PKJTb1**): Provider of customised solutions for mission control and space engineering.

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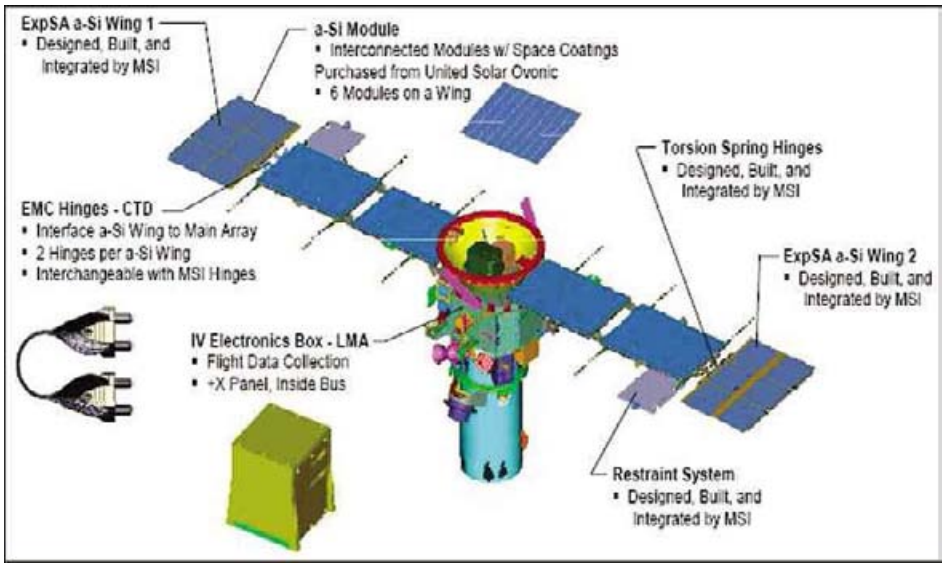
TacSat-1 in all its glory, and clever people in funny hair nets



TacSat-2, the original CAD presentation design

change, population expansion and pollution monitoring, for example.

Plus if you contribute to any of the projects, that would be one heck of a mention on your CV!

The available projects for download and manipulation vary from the creation of 3D aircraft models to GIS analysis tools for the mapping of the lunar surface. Each project is well referenced and can be downloaded from either Nasa-run sites, Sourceforge or GitHub, in a multitude of programming languages such as Python, Java or C for a variety of Linux/Unix platforms. All that's needed is to find a project that tickles your coding buds, follow the links, download the necessary files, unpack them and delve into coding heaven.

GMAT

GMAT (the General Mission Analysis Tool) is an open-source, platform-independent trajectory optimisation and design system. In other words, it helps spacecraft maintain their trajectories when in low orbit, lunar orbit and even deep space exploration.

GMAT uses a scripting language similar in syntax to the MathWorks MatLab system, with the user being able to analyse and model the space mission, then applying that analysis in a simulation to see what variables need altering, improving and so on.

The goal of the GMAT project is to help develop a new, more efficient space trajectory system, for the next generation of spacecraft and space propulsion. If you fancy having a go at sending a spacecraft into the final frontier or playing around with the trajectory of the International Space Station, then visit **goo.gl/XvbBDJ** for the latest source Linux build.

ViSBARD

ViSBARD (Visual System for Browsing, Analysis and Retrieval of Data) is another open source, Java-based, platform independent, interactive and graphically rich application that provides a way of visualising multiple vector and scalar qualities from the instruments on a number of spacecraft at once.

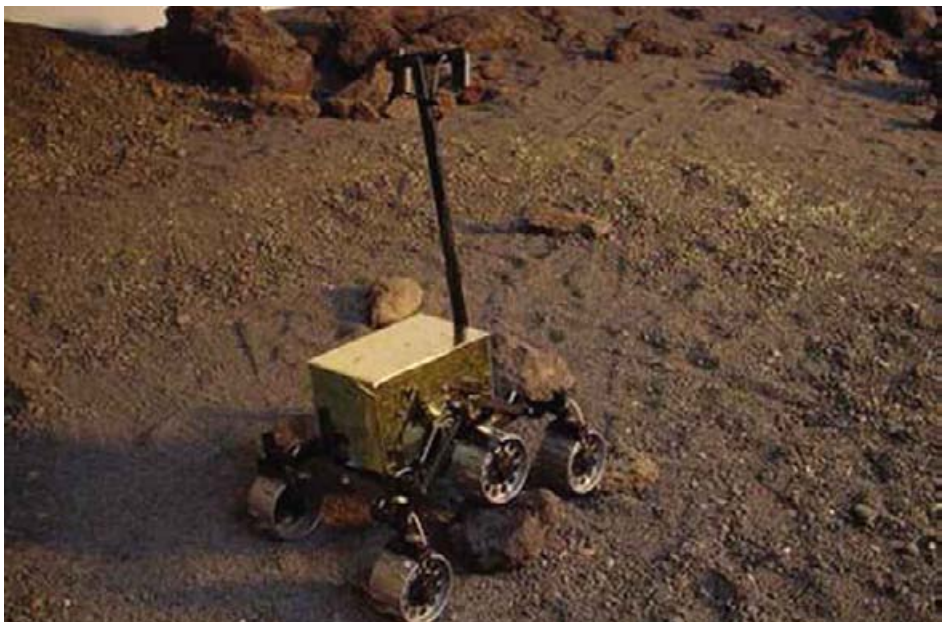
This results in an almost incomprehensible amount of data to interpret, so ViSBARD is capable of providing that data in an easily understood 3D coloured representation. Easy to understand provided you have a brain like old Albert E, for the rest of us, it looks very pretty.

To launch the application, all you have to do is browse to **goo.gl/R0NGj4** and click on the Java launch button. It takes a little while to load up, but it performs spectacularly on Linux.

TacSat-1

While Nasa may appear to be on the one-stop-shop for all things space related in America, it's actually just a small drop in the space industry, as there are now many advanced engineering companies and organisations that create and provide such systems and hardware that run on Linux.

Chief among these organisations are the Department of Defence and the Naval Research Laboratory. The US Department of Defence has a very chequered history with the militarisation of space and the objects



ExoMaDeR in action, using Linux to navigate the hostile terrain

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Testing different rover designs, all with Linux at the core

that it sends up there. But gone are the days of orbital nuclear platforms (allegedly, thanks to the Outer Space Treaty). These days, the DoD is more concerned with providing real-time data to troops in the field and helping command their naval and air force resources.

Of the many experiments it's conducted in the past, one of the most interesting to Linux users is TacSat-1 (Tactical Microsatellite Experiment), a joint DoD and NRL project, which was formally known as the Operationally Responsive Space Experiment and which provided imaging technologies.

The experiment was to design and build a small satellite in under a year and to provide a platform for operational experiments using a combination of custom-built systems and off-the-shelf components. Enabling the communication between these components was a base 2.4 Linux kernel, with a collection of BASH scripts controlling the payload between some very high-speed interfaces.

Although this may sound a little basic for the control of a satellite, especially when we've already seen that an RTOS is the only way to control such equipment, the TacSat-1 experiment was purely an experience builder, which paved the way for the far more successful TacSat-2.

TacSat-2

TacSat-2, since renamed to JWS-D1 (Joint Warfighting Space Demonstrator) is a second-phase NRL project that built on the techniques learned from TacSat-1.

Weighing only 415kg, this satellite was launched with a number of imaging, communications and GPS experiments that are designed to help mobilise ground forces.

Part of the payload, the Target Indicator Experiment, is run on a couple of Motorola MPC8265 PowerPC CPUs on PCI cards, with 128MB RAM and executed using free software developed by DENX Software Engineering's Embedded Linux Development Kit (ELDK) and DENX 2.4.25 Linux kernel, which, if you're interested, can be downloaded from **goo.gl/lVcQ0w**.

ExoMaDeR

Nasa isn't the only fruit in the space bowl. The European Space Agency is embracing Linux in its own specially modified way. Take, for example, RTAI (Real Time Application Interface) for Linux, an interface that allows you to write applications with strict timing constraints.

The ESA is currently developing RTAI for use in the ExoMaDeR planetary rover prototype, the next generation of Mars robots. Using RTAI on Linux, the developers are able to program real-time control over the motors of the rover, so it can traverse and explore the rugged Martian landscape autonomously, without any aid from ground control – useful when the distance between Earth and Mars is about 140 million miles.

For the rover's payload, a separate system was integrated, called XLuna and designed by Critical Software (**criticalsoftware.com**). XLuna (eXtending free/open source reaL-time execUtive for oN-board space Applications) is a Linux kernel that was designed for a variety of complex space missions involving payload and avionics. It runs as a stripped-down kernel on top of an RTOS called RTEMS (Real-Time Executive for Multiprocessor Systems) and is split into two subsystems that perform real-time tasks in tandem.

XLuna maintains the application layer that controls the payload on board the ExoMaDeR rover, which includes an analysis probe, trajectory tracking and external environmental cameras, as well as the CPU card, solid-state storage and wi-fi card for remote communications. But it's also used by the defence sectors in UAVs (unmanned aeronautical vehicles) and is fast becoming fully integrated into many of the ESA's payload systems for future operations.

The ESA's Mars rover project has since been upgraded to a larger design and is scheduled for a potential launch sometime in 2018.

Server Sky

This is an interesting project, which may one day become a reality. Server Sky involves shunting into orbit, ultra-light films of glass that are capable of converting sunlight into computational data and communications.

The 'Thinsats', as they're called, will be powered by a large solar cell array, and in constant contact with control via microwaves, and cooled by the near absolute zero temperatures of space.

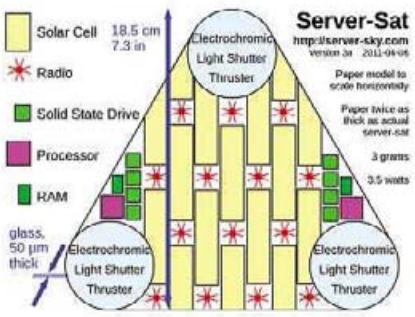
In theory, the Thinsats will be able to behave like massive orbital Beowulf clusters, providing huge amounts of parallel processing to the masses without the enormous energy drain and environmental problems that arise from ground-based data centres.

The project is still very much 'on paper' but the designer, Keith Lofstrom is developing a business case and looking for investors.

Ubuntu In Space

Of course, who could forget the ultimate reference to Linux in space with Mark Shuttleworth's legendary trip to the International Space Station in 2002, as a self-funded space tourist and the first African in space?

Apparently, he paid something in the region of $20 million for the privilege of being the second space tourist. Unfortunately, this was all done before Ubuntu was on the scene, but should he ever get to go up there again, who knows, maybe he'll take along a Linux laptop? **mm**



The theoretical data-centre in orbit

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Fix PCs Remotely

How to maintain computers remotely using nothing more than your phone. **Roland Waddilove** explores remote access

How do you repair and maintain computers without physically being there and getting your hands on them? One way you can do this is by using remote access software that enables you to perform tasks like virus scans, clean-up, tune-up and other maintenance tasks from another computer, tablet or phone. 360 Connect is one application that can do this, allowing you to maintain multiple computers with nothing more that your mobile phone.

There are several usage scenarios, but an obvious one is that you could keep an eye on all the computers at work. You probably wouldn't want to manage a thousand corporate computers this way, but if you had a small office or department of half a dozen computers, then 360 Connect could be used.

Another use is for maintaining family and friends computers. When people discover that you know a bit about computers and have an interest in them, you become the go-to person whenever something goes wrong. If you're often asked to fix your parents' PCs, your children's PCs, your granny's or friends PCs and so on, you might want to use 360 Connect to make the task easier.

What is 360 Connect?

There are two components to this. One runs on the computer that you want to monitor and maintain, and the other runs on your mobile phone, which can be either Android or iOS powered.

Go to the Google Play store or iPhone App Store and search for and install the free 360 Connect app on your phone. Run it, and after a few introductory screens, you're asked to sign in with your phone number. You can optionally connect Facebook too. Go ahead. You're now registered with 360 Connect as an assistance provider and can monitor and maintain computers.

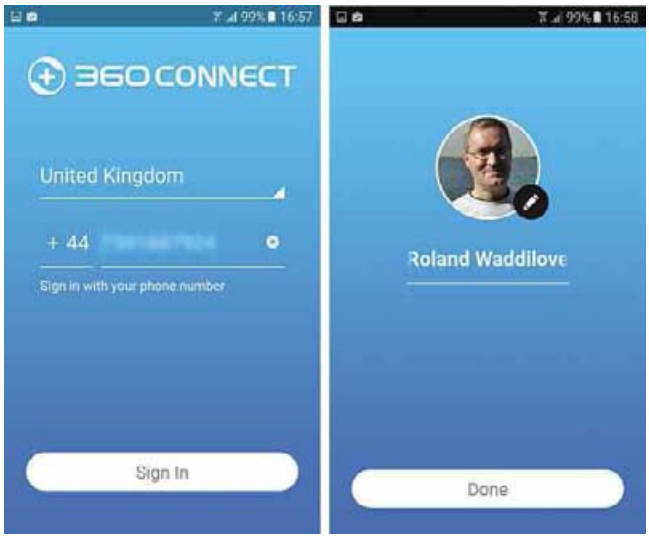
On the PC, you install 360 Total Security (**360totalsecurity.com**), which is a free security suite that contains antivirus, antispyware, a firewall, browser protection and much more. The name may not be familiar to you, which might make you wonder whether the security is really up to the job, but it offers a choice of Bitdefender or Avira antivirus engines. Both of these are well known and regularly perform well in antivirus tests by companies like AV-Comparatives and AV-Test. This means that the malware protection is good.

The developer is always adding new features to the software, and one of the most recent is 360 Connect. Open the main 360 Total Security application and select the Tool Box section on the left. Click 360 Connect on the right. Either you or the computer's owner needs to configure the software ahead of any problems or maintenance sessions. Once it has been set up, you have remote access; the computer user does not need to do anything.

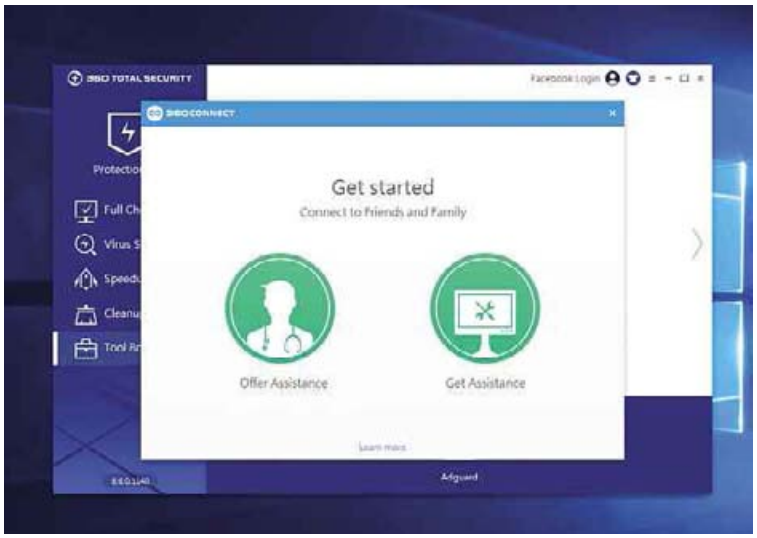
On opening 360 Connect in 360 Total Security, you're asked whether you want to offer assistance or you need assistance. Select the Get Assistance option. You're prompted to enter the phone number of the person who'll provide the assistance. You (or whoever is using the computer) should enter your phone number, the one you registered with 360 Connect.

Your phone receives a pairing request notification, and if you accept it, your phone and the computer are connected. This can be repeated for other computers, and a list of the computers your phone is paired with is displayed in the app. You can see brief details such as the operating system, processor, memory and storage.

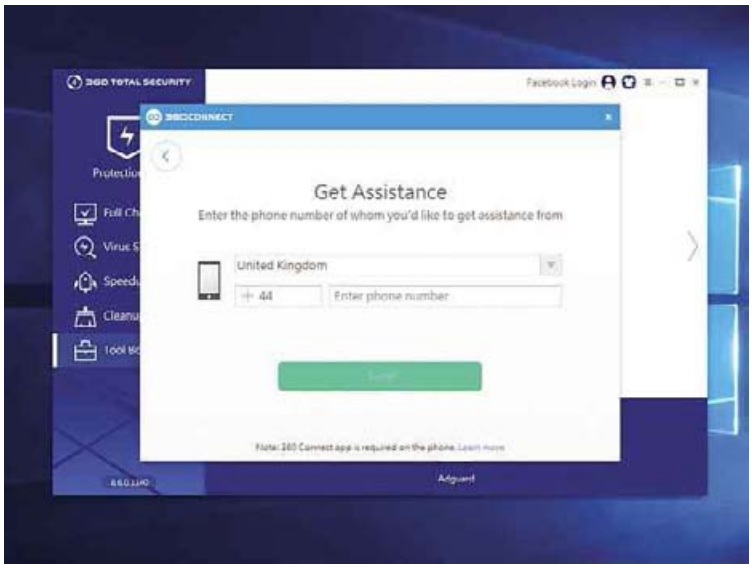
One of the consequences of pairing your phone with a computer is that you'll receive notifications about its status – for example, the time taken to start the computer, a low disk space warning,



1. Install 360 Connect on your phone and sign in with your phone number. This is the Android app



2. Install 360 Total Security on your PC, go to the Tool Box and open 360 Connect. Choose Get Assistance



3. Add your mobile phone number on the PC to sign in, and then assistance from that phone can be requested

4. The phone is paired with the computer, and you can choose which notifications you want to receive

malicious activity, risky website visits and suspicious activity. This makes it easy to monitor the status of computers, and you can quickly check if there's something wrong. The 360 Connect app enables you to exchange messages with computers, so you could say something like "Hey Dave, your computer took 5 mins to start up this morning, I'll check it."

The 360 Connect phone app enables you to perform a quick virus scan or a full system checkup. The 360 Total Security app not only provides malware protection, it also has speed-up and clean-up functions. It's like a one-click tune-up app, and you can launch this from your mobile phone remotely. The results of virus scans and tune-up checkups are displayed on the phone, and checkboxes enable you to choose whether to apply or ignore suggested fixes if any problems are found. The results are the same, as you would see on the computer, but you see them remotely on your computer.

Some of the tune-up optimisations are of dubious value, so you need to go through everything with care. For example, a recommended speed-up is to turn off OneDrive. It may well speed up the computer, but the tweak isn't useful if you rely on OneDrive for syncing and storing files online. It would be a good idea when setting up the software on a computer to run the clean-up and speed-up tools in 360 Total Security and add settings or files you don't want changing to the exception list. They will then be ignored when scans are performed.

The mobile phone app and the Windows software work well together. Pairing them is easy, and running security scans and clean-up/tune-up complete scans is easy. It's worth considering if you provide support to family and friends. **mm**

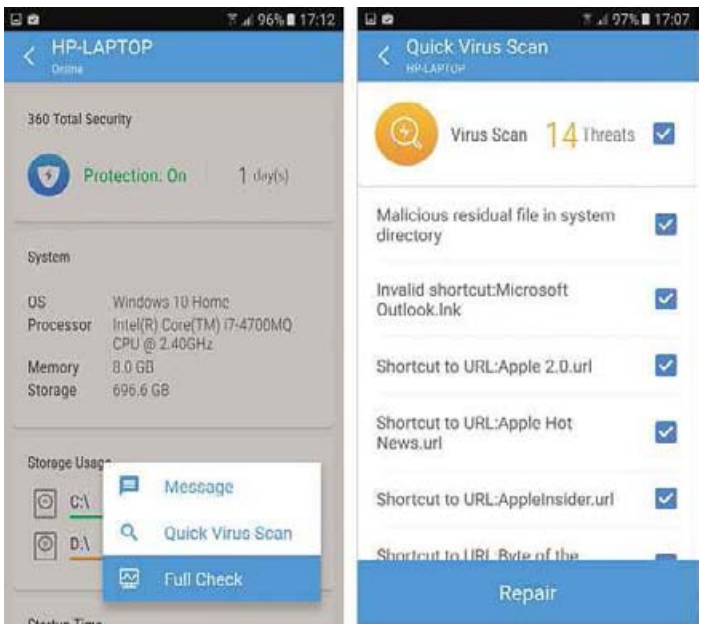
Alternative remote access

360 Connect enables you to access only one program on your computer, which makes it a bit limited for complete maintenance of a PC remotely and there are programs that enable more comprehensive access.

TeamViewer (**teamviewer.com**) is free for home users, and there are two components to the system. You install software on the computer you want to control and then install the software on another computer, phone or tablet. You can then remotely access everything on the target computer remotely.

Unlike 360 Connect, which just provides access to a couple of functions and issues commands, TeamViewer can show you the full screen of the target computer. It's like sitting in front of the computer yourself, and you can do anything, such as run any program, change any system settings, install software, delete files and software and so on. TeamViewer is much more powerful, and the features it provides are far more extensive.

LogMeIn (**logmein.com**) is like TeamViewer, but it's aimed at businesses, with appropriate prices, and there isn't a free version. Splashtop is another similar app that provides remote access. You can access a computer on your home network from another computer, phone or tablet for free, so you can access a bedroom computer from the comfort of your sofa in your lounge, but to access a computer remotely costs around £18.



5 Run virus scans or full system tune-up and clean-up scans, and then select which fixes to apply

Alphabet Pi: U

David Briddock meanders through Raspberry Pi technology from A to Z

THIS WEEK: USB, PyUSB, Update and Upgrade and UART

USB

Every Raspberry Pi comes with at least two Universal Serial Bus (USB) ports; the Pi 2 and Pi 3 have four. These are all full-sized ports, except on the Pi Zero, which has micro-USB ports due to space restrictions. Currently, these adhere to the USB 2.0 standard, rather than the faster 3.0 specification.

In addition to attaching a keyboard and mouse, USB ports can be used to add extra memory storage, an external hard drive, a wireless dongle (wi-fi or Bluetooth) and much more. That means, even with four USB ports, it's pretty easy to run out of spare capacity.

Using a wireless keyboard and mouse is a good way to free up some USB ports as well as reducing cable clutter. But another solution is to buy a multi-port USB hub. A basic multi-port hub is fine for keyboards, mice and similar items with minimal energy consumption requirements. However, a powered hub is a more flexible solution, because it also supports devices such as external hard drives.

▲ *Raspberry USB hub*

> **PyUSB is written in Python and simplifies access to the USB communication protocol**

There are also some do-it-all hubs that provide enough power to run the Pi board itself, as well as other power-hungry accessories. One of these hubs also comes in a rather attractive Raspberry-themed case (**goo.gl/hcmJRv**).

PyUSB

Writing code to interact with USB-connected devices can be a rather technical business, but use the PyUSB library (**walac.github.io/pyusb**) and things are much easier.

PyUSB is written in Python and simplifies access to the USB communication protocol. It works with just about any Python installation, from version 2.4 upwards, and has built-in backends for libusb 0.1, libusb 1.0 and OpenUSB.

There are a number of modules within the PyUSB library. These cover core USB functionality, control requests and backend interfacing.

Update And Upgrade

Two of the most important Raspbian terminal commands are 'update' and 'upgrade'. Used frequently in combination, they'll keep your Raspbian image up to date. You'll need to call them, one after the other, before installing something new onto the Raspbian operating system.

First, type the command 'sudo apt-get update' in a LXTerminal window to refresh the operating system's package list. Any new versions of these packages will be downloaded and installed automatically.

Second, type 'sudo apt-get upgrade' to automatically downloaded and install any newly introduced operating system packages, including kernel and firmware level software. This command also shows the amount of data to be downloaded and the space required for installation.

If you're not sure how much free space there is on your Pi's SD card, use the terminal command 'df -h' to find out. And you can gain more space by cleaning out the package file cache archives, stored in the /var/cache/apt/archives directory, with the command 'sudo apt-get clean'.

UART

The Raspberry Pi's Broadcom chip includes universal asynchronous receiver/transmitter (UART) support. UART is used for low-level serial and parallel communications, where bytes of data are transmitted bit by bit in a sequential fashion.

For compatibility reasons, UART data formats and transmission speeds are configurable. This means it can be used in conjunction with a variety of common communication standards such as RS-232, RS-422 and RS-485. **mm**

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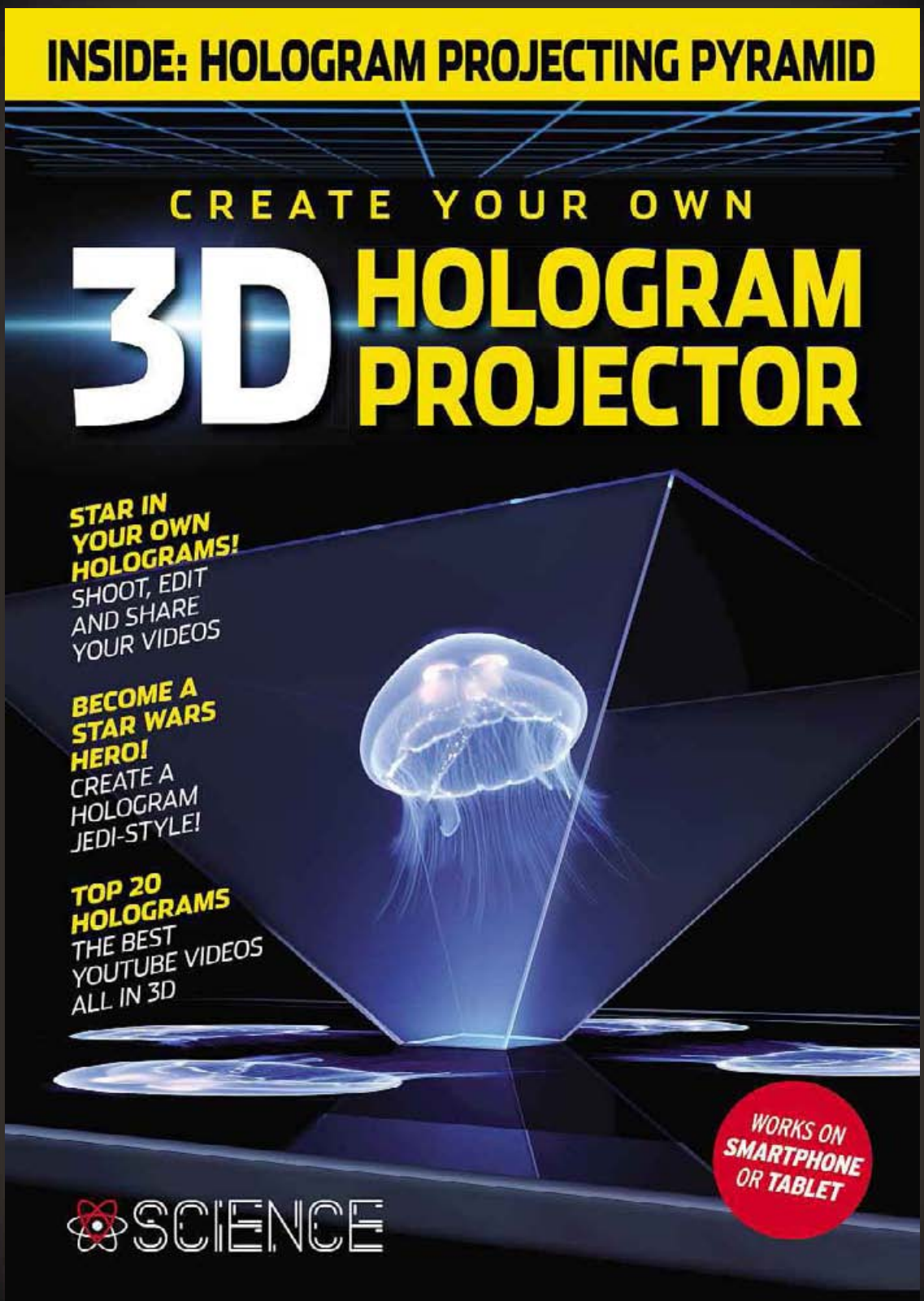

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Component Watch

Component Watch

Adding wireless to your PC is easy with one of these USB adapters

USB wireless adapters have a reputation for being low-quality, but that's not always the case. Although the bottom end of the market is full of devices that do the bare minimum in hardware and suck processor time from your main CPU to manage their communication, you can get good ones too. This week, we're looking at the best USB wireless adapters around.

Deal 1: Asus USB-AC56
RRP: £59.99 / Deal Price: £40.29

This dual-band wi-fi adapter is the Rolls Royce of USB adapters, incorporating a full-size antenna, Wireless AC1200 speeds, extension cable, cradle and endcaps for portability. It's best for speed and convenience, and it looks great too. It's quite expensive compared to the cheapest USB adapters, admittedly, but for what you get, it's actually pretty reasonable even compared to an internal wireless card.
Where to get it: Transparent – bit.ly/2a2NcFF

Deal 2: ZyXEL NWD6605
RRP: £44.99 / Deal Price: £32.81

This dual-band USB adapter supports Wireless AC1200 and WPS, but its real selling point is a nifty fold-out design, which keeps it compact while giving it a decent antenna coverage as well. If you're trying to find a good balance of price and performance, this one definitely fits the bill even if you do get slightly fewer perks than the Asus model we just looked at. We're not talking about huge sums, but for 20% less, it's an incredible bargain by comparison.
Where to get it: Una Technology – bit.ly/2ajdEgd

Deal 3: Netgear WN3000RP
RRP: £34.99 / Deal Price: £29.69

The last AC1200 USB adapter we'll look at comes from Netgear, whose pedigree is about as assured as it gets when it comes to networking hardware. With a cradle, extension cable and sleek slide-out antenna it's certainly an impressive piece of kit, and the speeds speak for themselves. There's not a lot to distinguish it from the Asus and ZyXEL models other than the price, but it is lower than the others, so maybe that's enough!
Where to get it: CCL Online – bit.ly/29Oblkt

Deal 4: Asus USB-AC51
RRP: £29.99 / Deal Price: £23.99

Trumpeting itself as the smallest Wireless AC adapter on the market, the Asus USB-AC51 is an ideal companion to a laptop, and offers an instant upgrade to older hardware. It can deliver speeds of up to 433Mbps with selectable dual-band connection, and requires only a USB 2.0 port to work. It even contains an LED indicator so you can see what the connection is doing at a glance, which is more helpful than low-end versions of this device might offer!
Where to get it: Box.co.uk – bit.ly/29YbMav

Deal 5: Linksys AE3000
RRP: £29.99 / Deal Price: £29.84

Like other high-end wireless adapters, the Linksys AE3000 comes with a cradle/stand for better orientation and stability during use, with an optional extension cable. Although it's Wireless N900 instead of AC, you can still expect fast dual-band speeds and at a good price too. Whether you want Wireless N kit at this price is debatable, but if you do, this is the adapter to go for!
Where to get it: Ebuyer – bit.ly/29OeLDU

Remembering... The Arcades

David Hayward recalls neon-lit caverns full of digital treasures and sticky carpets

I was lucky where I grew up in that there was an exceptionally well-stocked arcade in the town. The proprietor prided himself on the fact that he could get hold of some of the most sought after cabinets and even some of the lesser-known machines from America. Needless to say, I hung out there quite a bit when I was a lad.

A recent trip to the arcades that litter the promenade of Great Yarmouth brought me back to my time as a youth, but there was a sense of disappointment when I sampled what a modern arcade had to offer.

Gone were the *Space Invader* type games, along with *Pac-Man*, *Galaga* and even pinball machines. Instead, there were rows and rows of gambling machines or those flat machines where you have drop a two-pence piece at the back to force the ones at the front to fall down. Also, there were a number of strange ticket dispensing machines that were really glorified large Android devices. It's difficult to love a gambling machine.

Now I don't expect to find *Galaga* or even *Rygar* amongst the modern cabinets, times move on, but there wasn't even a decent racing game – *Sega Rally* was broken down, sadly. It made me quite sad really and got me thinking: how would an 80s arcade fare in the modern world? I'd like to think that it'll do well, given the novelty of a modern teen playing a 30-year-old game; plus the older generations would certainly crack a smile at trying to hit that Q*Bert high score again.

Its history

There's some confusion as to when the 'arcade' actually began. Some credit the start of the arcade with the release of *Pong* from Atari, back in 1971/2. Whereas others would have the start of the true arcades as 1978 with the release of Taito/Midway's *Space Invaders*. Naturally, you can look even further back, even as far as the 50s for an arcade full of pinball machines. But in this instance, we'll look to the coin-op digital world that began with *Pong*, Space Invaders and so on.

Either way, we can safely say the arcade that we grew up with began somewhere in the 70s, with its golden era lasting up to at least 1985, when the profit made in U.S. revenue dropped from a staggering $13 billion per year to just $400 million.

After 1985 the profit did rise slightly, based on American revenue of the arcades, to around $600 million, but it never really recovered, and when the 90s hit, the arcade market once again slumped – only this time it never recovered.

Of course, the main culprit for the decline in the arcade industry was the home computer and the consoles. Where once we had to go to an arcade to enjoy digital entertainment and subsequently sink several ten pence pieces into the machines, we could now do from the comfort of our own homes at a fraction of the cost.

As home entertainment evolved and became more powerful, finally overtaking the quality that the arcades to deliver (look to *Marble Madness* on the Amiga for evidence of that), the arcade games that once ruled were eventually covered in a dust sheet and sent to spend the remainder of their days in a lock-up somewhere.

Did You Know?

- You could find mini-arcades set up in places such as supermarkets, off-licences, petrol stations and even funeral homes.
- Arcade revenue was three times that of movie ticket revenue in 1981.
- *Pac-Man* was the highest grossing machine, with over 400,000 units sold. *Space Invaders* came second with 360,000 units sold, and *Street Fighter 2* third with 200,000 units sold.
- Vector Displays brought in a golden age of arcade machines, with the likes of *Asteroids* and *Star Wars*.

The Good

The ambience: the neon-soaked, sticky carpeted, slightly smelly arcade with bells, whistles and a cacophony of digital soundtracks. Competitions to see who get the highest scores in the town and some cracking games to play and beat.

The Bad

Expensive. **mm**

Is there a more beautiful sight for a gamer than a well-stocked arcade?

Pac-Man is the most sold arcade unit in history

Pinball machines, though, were the granddaddy of the arcade world

TNMOC Opens New Hub

Pokémon No Go Zone In US

Holocaust Memorial Museum tells players to steer clear

This Pokémon Go app has become a bit of a phenomenon, hasn't it? It's been the subject of many a news report around the world, and it's fair to say that the app has also ruffled a few feathers since its launch. There have been warnings from police departments in the States over concerns for gamers' safety, and there have been several accounts of gamers being attacked and getting injured while playing the game. It also appears that some of the locations that Pokémon can be found within the game are completely inappropriate.

For example, the US Holocaust Memorial Museum has told players not to play the game on site, calling it "extremely inappropriate". There are apparently some virtual Pokémons inside the museum based in Washington, and the museum, rightly so, has decided that mobile gamers walking around with mobiles in hand while they go about their virtual hunt isn't something it wants to encourage. The museum's communications director has been quoted in the press as saying that they're trying to have the museum removed from the game.

Developer Niantic has clearly developed a mobile experience that has absolutely captured the public's imagination. As for Nintendo, it's seriously benefitting, with shares having risen by 70% in the first few weeks of the game's launch, and things are showing no signs of letting up, as Reuters has reported that Niantic is looking to roll it out to 200 markets. Of course, now that the app has been launched over here, you too can walk around the streets with your eyes permanently glued to your mobile. Gotta catch 'em all?

QUICK BITS... **Microsoft has updated its Skype for Linux client. About time too**

Showcases classroom tech

Our friends at The National Museum of Computing have told us that it now hosts a Fujitsu Innovation Hub, housing the latest in classroom technologies.

The hub is a collaboration with Fujitsu UK plus other partners including Intel, and the idea behind it is to help students directly compare and contrast technologies past and present. It contains an array of Fujitsu tech including tablets, hybrid devices, laptops and desktop PCs running on the latest Intel Atom and Intel Core processors.

If you visit the museum, you'll be able to take a look for yourself, while TNMOC is also planning to use the hub as a regional community resource for households that have limited access to technology. While you're there, check out the TMNOC Classroom next door, which houses BBC Microcomputer workstations. Lovely.

Tesla's Autopilot Blamed For Another Crash

Troubling times at Tesla

Tesla has admitted that a crash involving one of its Model X vehicles did take place while the autopilot feature was enabled.

Fortunately for all involved, there were no fatalities in the accident that took place earlier this month in Montana. The Detroit Free Press reported that the Tesla vehicle crashed into a wooden guardrail after veering off the road, with the driver ultimately being able to intervene to stop it from going off the road completely. In a statement on the matter, Tesla said that "no force" was noticed on the steering wheel for over two minutes after autopilot had been engaged, which is against the company's terms of use when driving the car.

Elon Musk has confirmed that the company isn't planning on dropping the autopilot feature, despite all of the recent media activity. He has also tweeted that "we don't mind taking the heat" for customer safety, and he will be pleased that other news reports have since emerged relating to another crash in one of its Model X cars in early July, because it turns out autopilot was not engaged, despite the driver having initially told police that it was.

Meanwhile, Consumer Reports magazine has urged Telsa to disable the automatic steering function and also rename the autopilot system, as it suggests that the vehicle can drive on its own.

Does it matter that ARM is due to be taken over by the Japanese telecoms firm SoftBank? That's a question I've been asking myself since I heard about the proposal, which ARM has accepted.

It's certainly sad to see a successful British business being taken over by foreign interests, but surely it's not the end of the world? After all, if SoftBank keeps everything running as it is now, with the same employees and the same business model, then it's still good for the country, surely? Indeed, if it creates more jobs for British people, then even better, right?

Perhaps, but as people have been pointing out, SoftBank has an enormous amount of debt already (about £86 billion). And experts have suggested that any profit from ARM will be used to pay off that, rather than being invested back into R&D, as it probably would be now.

Furthermore, according to the Guardian, the whole deal could now be in doubt (**goo.gl/i8cl1y**), but if it does go ahead, it has the potential to completely change the face of modern technology – and not necessarily for the best.

What do you make of it all? Write to **letters@micromart.co.uk** and share your thoughts.

Anthony

Caption Competition

With one small step, we take a giant leap into this week's caption competition…

- **doctoryorkie:** "The new Apple price list. Out of this world.
- **JayCeeDee:** "$12 million for this space suit and I still can't use a touchscreen!"
- **EdP:** "I wanted to be a train driver when I grew up."
- **EdP:** "Your Game Boy has more computer power than the Apollo capsules."
- **Mad Malc is back:** "Hi, kids, this cool outfit came free with a job lot of second-hand Sony batteries."
- **Thomas Turnbull:** "So much for Apple Maps; this is supposed to be the moon."
- **doctoryorkie:** "I was the second man on the moon. Neil before me."
- **Thomas Turnbull:** "Has any of you kids seen my moon buggy; I'm sure I left it around here somewhere."
- **Jim Brock:** "Neil Armstrong five minutes after filming the moon landing."
- **Terry Martin:** "What should you do if you see a spaceman? Park in it, man."

Thanks for all your entries. And well done to doctoryorkie, who is this week's winner. His caption: "I normally hang out in the space bar."

If you have a caption for this picture, head to the 'Other Stuff' section of our forum (**forum.micromart.co.uk**), or email us via **editorial@micromart.co.uk**, remembering to add the issue number to the email subject line.

Jaguar Land Rover Testing Autonomous Vehicles

Serious plans for next four years

The UK isn't planning on being left behind in driverless cars, as Jaguar Land Rover has announced that it will create a fleet of over 100 research vehicles over the next four years in order to test its own autonomous technologies. Those technologies include 3D mapping to allow the car to recognise barriers, while radio communication between cars should also help for better safety.

Testing will take place around its Coventry HQ, and with the grand plan in the UK for driverless cars to be made available to the public by 2020, this announcement certainly helps to fuel that potential dream (or nightmare, depending on your view of autonomous vehicles).

Online Referendum Petition Will Be Heard In Parliament

Four million signatures means debate will go ahead

We're not sure if you're aware, but there was a rather important vote that took place in Britain recently. It's led to a fair degree of political upheaval, and while many are pleased with events, others are less so.

If you were one of the four million people to sign the online petition calling for a second EU referendum, your opinion will be heard. The Commons Petitions Committee has said that the petition will indeed be debated in parliament on 5th September, and you can even watch that debate on **parliamentlive.tv**.

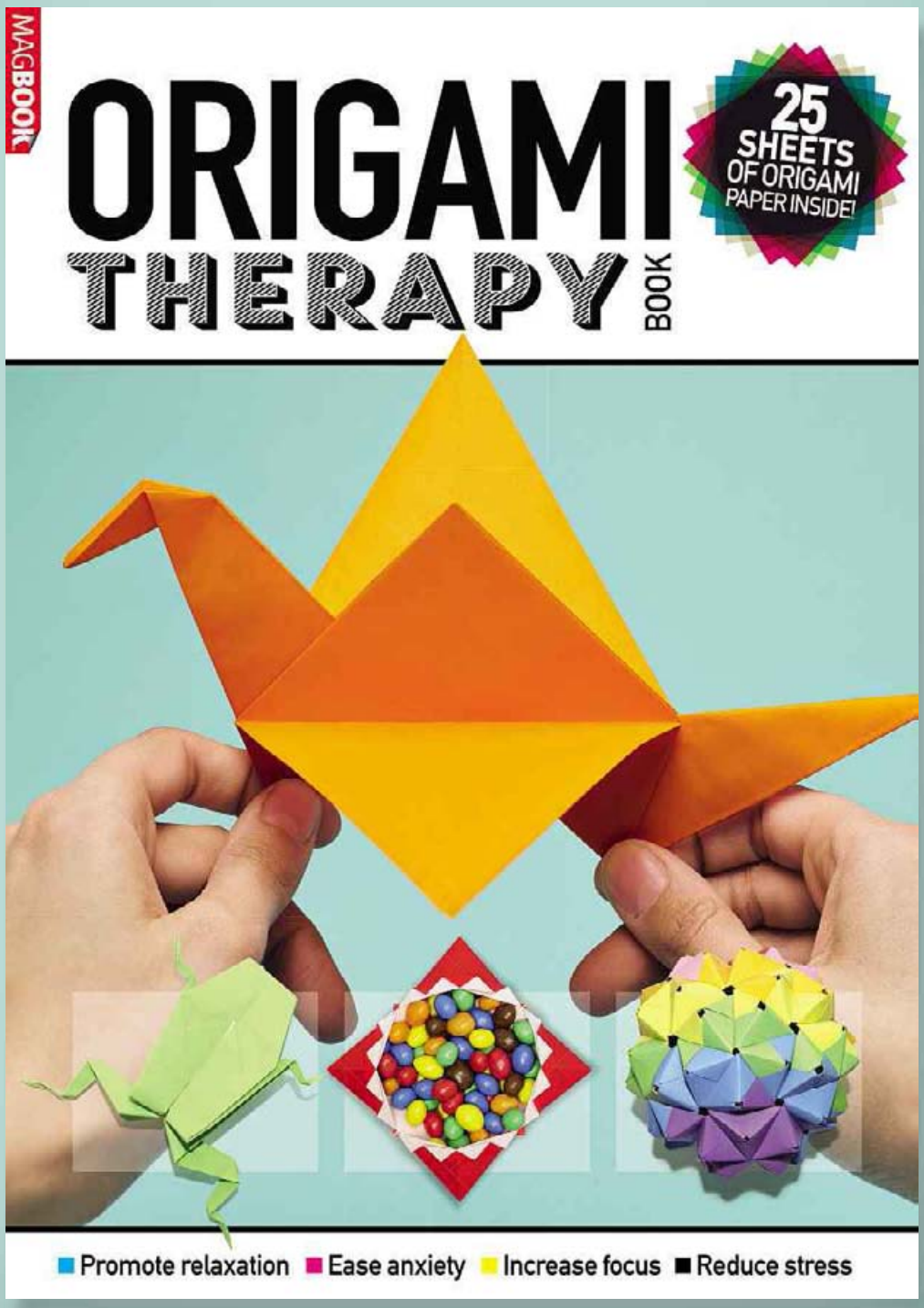
The debate itself will essentially put forward people's concerns about the referendum process and the subsequent decision that was made, with those concerns then receiving some sort of response from a government minister.

The power of e-petitions, eh?

 QUICK BITS... Microsoft has begun its downgrade of OneDrive accounts to just 5GB storage

Time to relax!

Forget your surroundings and gently unwind your body and mind



Order your copy from www.magbooks.com

Snippets!

Sainsbury's Trials One-hour Delivery Service

Amazon has done it, and now Sainsbury's wants to try out its own one-hour delivery service.

It's called Chop Chop, and the trial will take place in London, with interested consumers living within 3km of the Wandsworth store having to pay £4.99 per order. Sainsbury's has set up an app for iOS users to order up to 20 products for home delivery within an hour of their order.

First Amazon Now, now Chop Chop. Will anyone else follow suit?

Scientists Create Pac-Man-style Experiment

When scientists wanted to understand how microorganisms interact with each other, specifically looking at how some hunt and some are the hunted, what better way to do so than by setting up a simulation of Pac-Man.

Scientists from the University College of Southeast Norway created a Pac-Man maze, in which the microorganisms could chase each other, with some playing the role of the ghosts.

There are a few video clips on this over at YouTube. Well worth a look.

Amazon Prime Day Proves Profitable

Amazon has said that its second Prime Day saw customers placing 60% more orders worldwide compared with the first Prime Day last year.

Also recording the largest daily sales for Amazon devices, the Fire TV Stick was the best-seller on the Prime members-only day. This is all particularly good news for Amazon, of course, and given that this year's Prime Day started out with a few technical hitches as shoppers couldn't add things to their shopping baskets, the company will be pleased things turned out nice again.

Auslogics Upgrades BoostSpeed

Windows optimiser tweaks tools

Auslogics' flagship Windows optimiser software has been handed a major upgrade.

BoostSpeed 9 is an award-winning all-in-one suite of computer tune-up tools, and this latest update includes a multi-language GUI, plus a new Win 10 Tweaker section, offering a bunch of optimisation options for Windows 10 and enabling users to apply tweaks under three categories: Privacy Tools, Visual Tweaks or System Tweaks.

Reading between the lines, Auslogics has also sorted a few annoyances for current Windows 10 users too, and you can download a free trial version from **www.auslogics.com/en/software/boost-speed**.

Robot Runs Over Toddler

Child okay after security bot strikes

This is hardly news that will calm concerns over robots' inability to mess up human tasks.

A security robot installed at a shopping centre in America ran over a 16-month-old child as it apparently tried to get out of the young chap's way. The 5ft tall, 300lb autonomous machines are developed by a company called Knightscope, and they are a heck of a size for young kids to contend with, as you can imagine. The company was at pains to inform the world of the many thousands of miles travelled over many thousands of hours without incident.

A press release issued by Knightscope said, "The machine veered to the left to avoid the child, but the child ran backwards directly into the front quarter of the machine, at which point the machine stopped and the child fell on the ground. The machine's sensors registered no vibration alert and the machine motors did not fault as they would when encountering an obstacle… The entire incident lasted a few seconds and a scrape on the child's leg and a bruise with minor swelling were reported."

The family has since been invited to the firm's HQ to see the technology up close, which seems an odd idea – particularly for the poor kid.

QUICK BITS... Microsoft admits that it won't hit its target of having Windows 10 on a billion devices

Sega Saturn DRM Cracked

Some people have a lot of spare time on their hands...

A video has emerged on YouTube that demonstrates a chap's successful work on cracking the Sega Saturn console's DRM.

The video has already amassed hundreds of thousands of views, and it shows the chap, one 'Dr Abrasive', working out how to engineer a plug-in flash card for the console. The Sega Saturn's copy protection was pretty excellent, detecting physical marks found on the outside of the game CDs that allow them to be played. He ended up coming up with a custom-made interface to use the console's Video CD slot to load images from a USB drive that basically emulates the disc drive.

This guy really got his geek on (it took him three years to get to this point, apparently), and the YouTube video, titled 'Sega Saturn CD – Cracked after 20 years' is a surprisingly fascinating watch.

Nintendo Goes Retro As NES Returns

Mini replica goes on sale in November

Rewrite the Christmas wishlist. Nintendo has made a direct play for those nostalgic types among us all by announcing the Nintendo Classic Mini: Nintendo Entertainment System.

This pint-sized replica of Nintendo's all-time classic console plugs directly into a television using the included HDMI cable and comes complete with 30 NES games already installed. The list of 30 is a veritable who's who of Nintendo's finest, including *Super Mario Bros.*, *The Legend of Zelda*, *Metroid*, *Donkey Kong* and *Kirby's Adventure*.

The Classic Mini: NES comes packaged with one controller and a USB cable for powering the system, although the UK version won't come with the AC adapter that our US friends will get. Annoying.

The price of this retro goodness is $59 for US consumers, which may or may not translate to a similar UK price; we don't know about that just yet. What we do know is that this will be a very, very tempting purchase for many (us included).

Fiat Chrysler Brokers Bug Bounty Deal

Does it on the cheap

Given last year's hack of Chrysler's Jeep car, it makes sense that Fiat Chrysler should come up with a bug bounty scheme to encourage people to track down and inform the company of any software flaws in its software.

Some were surprised, then, to learn that the company is offering rewards starting at just $150 for the provision of details of flaws in those software systems. The most serious rewards come in at $1,500, which again is hardly likely to encourage people to get involved. For comparison, Google's bounty rewards program offers up to $20,000, although that too does have rewards starting off at the lower end of the spectrum at $100.

by 2018

Archos 50 Power

A Lollipop phone with impressive longevity

DETAILS
- **Price: £139.99**
- **Manufacturer: Archos**
- **Website: goo.gl/gzIFGh**
- **Requirements: Google account, appropriate SIM**

Archos's smartphones offer excellent mid-range devices for those who want cutting-edge technology, without the financial burden of higher end devices.

The company's most recent release, the Archos 50 Power, could easily be mistaken for a high-end device when you read the specification. This is a 5" IPS HD device with a maximum resolution of 1280 x 720 and a five-point capacitive full lamination process screen. It's driven by a 1GHz MediaTek MT6735P quad-core processor, a Mali 720 GPU and 2GB of memory with 16GB of internal storage.

Connectivity is good too, with an SD card for up to 32GB cards and dual SIM support with either micro or nano SIMs or both, placement options. There's also a mini-USB port, 802.11ac wi-fi, 4G/LTE, Bluetooth 4.0, audio out, a 2MP front camera and a 13MP rear camera.

The matte-black plastic casing is tough enough for most uses, but don't expect it survive a drop from pocket height when standing. The Corning Gorilla Glass, though, makes up for any lack of toughness. Its 145 x 72 x 9.2mm dimensions feel good in the hand and easily slip into a pocket without any discomfort. And at just 148g, it's reasonably lightweight and too bulky.

One of the main specs, though, is the long battery life, hence the Power title. The 4000mAh battery is said to last at least a couple of days before it needs to be charged. In our tests, using it normally: sending and receiving emails, light browsing, using the camera and video function for a few minutes and so on, we did manage to squeeze eleven hours of the battery before it was time to plug the device back in. When on idle, at minimum screen brightness and with the wi-fi turned off, that time was extended to around 36 hours, which again is a pretty impressive amount of time.

Its performance was good; we'd put it on a par with a Nokia Lumia 550. It won't deliver blistering speeds, but for the vast majority of users, who aren't into fast-paced mobile gaming, it'll more than suffice.

The display was good too, with the IPS screen delivering a better than average degree of colours and clarity. We did feel, however, that even at full brightness the screen was a little too dark for our personal tastes, but again it's sufficient for the vast majority of users who are after a mid-range device.

You'll find Android 5.1 installed, with access to Google Play and a smattering of third-party applications and games. They can, of course, be removed or stopped when they begin the install after initialising the phone, thus saving you some space. If you do install everything, you'll only have around 9.5GB of storage left.

The Archos 50 Power is a decent mid-range device. It's not the quickest phone available, but the display is good, and the battery life is excellent, plus it's dual SIM, and it only costs £139.99.

mm David Hayward

Inexpensive, with a fantastic battery life

Overclockers Kinetic H3 Gaming PC

Nvidia versus AMD: who will win the next-gen GPU battle?

DETAILS
- **Price: £719**
- **Manufacturer: Overclockers UK**
- **Website: goo.gl/RZ0xVm**
- **Requirements: Keyboard, mouse, monitor**

Recently, we reviewed the new Nvidia GTX 1080 and 1070 graphics cards in Overclockers' Titan ForceBox VR-ready system. Both cards performed magnificently, with the GTX1080 hitting a 3DMark 11 score of 15,493.

Now it's AMD's turn, with the Radeon RX480, a card that offers gamers almost as much performance as Nvidia's newest generation, at a fraction of the cost.

The Overclockers UK Kinetic H3 Gaming System features a 2.7GHz Intel i5-6400 processor with a turbo frequency of 3.3GHz. There's 8GB of DDR4 2400MHz memory, a Kingston SSDNow UV400 240GB SSD with Windows 10 Home 64-bit edition on it and a further 1TB Seagate hard drive as a secondary mass storage device.

The Sapphire Radeon RX480, though, is the star of the show here, with its new Ellesmere GPU, 14nm manufacturing process, GPU clock speed of 1120MHz (with a boost to 1266MHz) and 8192MB of GDDR5 memory. It's an impressive card and one that offers 2304 shading units, a TDP of 120W and outputs that consist of a single HDMI and three DisplayPorts.

At its heart is the Sapphire Radeon RX480, a superb GPU

The OCUK Kinetic H3 is a splendid gaming system

The Sapphire Radeon RX480 manages all this for around £230 too, which is considerably cheaper than the average Nvidia GTX 1070 price of around £450, and even more so of the GTX 1080, which can tip the scales at an eye-watering £690.

In terms of performance, the system managed a 3DMark 11 score of 12,670. This is a surprisingly excellent score from AMD, since its contributions to the PC haven't been all that great in recent years. In fact, there's only a 2,823 point difference between the RX480 and the GTX 1080, and since the price of the RX480 is a third of Nvidia's flagship GPU, you could happily buy two RX480s for a CrossFire setup while enjoying superb frame-rates and still have money left over.

Back to the Kinetic H3, though. OCUK has opted for an Asus H110-Plus motherboard, which gives room for some upgrade potential and a stock Intel cooler. The Kolink Refractor Gaming Case is superbly designed, with a front shaded window revealing the pair of 120mm blue LED fans and a further 120mm blue LED at the rear of the internal chassis.

Needless to say, the Kinetic shows the usual high degree of craftsmanship that OCUK prides itself on. The internal layout is excellently designed, with all cables neatly tucked behind the motherboard backplate. It's also a remarkably silent PC too, despite the stock cooling used – even when under the stress of a benchmark. There's also a three-year warranty, 24-month collect and return and 12-month labour included with the system.

The Overclockers Kinetic H3 Gaming PC is priced at £719 and is worth every penny. We've been a little disappointed in AMD of late, but the introduction of the RX480 has impressed us. When used in a system such as this, it's one of the most cost-effective gaming GPUs we've seen in ages.

mm David Hayward

An excellently built system

BT Smart Hub

Mark assesses if the new BT Smart Hub lives up to its claims

DETAILS
- **Price: £129.99**
- **Manufacturer: BT**
- **Website: goo.gl/QPbNex**
- **Requirements: BT broadband service**

Despite the new name, this system identifies itself as Home Hub 6, so it's a replacement for the five previous incarnations of BT's own router solution. As one of their customers (for now), the BT Home Hub series has got progressively better, though some early attempts were exceptionally bad.

In terms of specifications, the Home Hub 5 was almost the bottom rung of the 802.11ac wi-fi class ladder, having no appreciable MIMO capabilities even on 2.4GHz. As a result, lots of people complained about the relatively poor wi-fi connectivity it offered and how far behind the technology curve BT was. Home Hub 5 offered 1,300Mbps on 5GHz and just 300Mbps on 2.4GHz, giving an AC rating of just AC1600.

Arriving almost three years on from version 5, the Smart Hub appears to have been designed to address numerous wi-fi related problems. BT built it with no less than seven antennas fitted in its enlarged case, allowing for 3x3 MIMO on 2.4GHz connections and 4x4 MIMO on the 5GHz range. That's 1,700Mbps and 450Mbps respectively, or AC2200 as it is referred to. BT claims that this antenna functionality allows the Smart Hub to stay connected to smartphones up to 300m through a single wall, 350m for tablets, and 500m for a laptop.

> **"It could be money well spent if it avoids the need to install a wi-fi extender"**

But before I get to the reality of that, I should point out that this has both ADSL2+ and VDSL2 modems, allowing it to work with whatever BT service you have. It's also a four-port gigabit hub, and it has a USB port to allow the sharing of files across the network.

Nothing especially radical in that line-up. And the USB port is only USB 2.0, so it won't be transferring anything quickly to wired or wireless connected devices, in case you wondered.

There are some minor improvements over the Home Hub5 in respect of the IPv6, but when it comes down to it, the Smart Hub is being pushed hardest on its improved connectivity. For that reason, I extensively tested it, and it is an improvement over Home Hub 5 in regard to signal range and quality. However, I got absolutely nowhere near the connection ranges that BT is claiming.

My most useful test was to take my Dell XPS 13 for a wander around my home, to perform a wireless site survey for both the ground floor and upstairs. Despite having a very small home, connectivity on the first floor when not above the lounge wasn't great previously, and with the Smart Hub it is much better. That said, 802.11ac wasn't built for range but performance, and to get a good signal level outside the room where the router resides you need to use 2.4GHz and not 5GHz.

As for those incredible ranges? I don't need Ryan

Reynolds or a helicopter to tell me that these are high numbers optimistic at best. The furthest I got away from my home with a phone, with a single wall between me and the router was 60-70 metres. The signal was detectable further away, but it wouldn't connect.

Using a laptop I managed to get at least 120m away and still be connected, which is good if you've got a big garden, and bad if you've ever let your neighbours find out your router password. What I don't have an issue with are BT's claims about speed, because once you've established a decent connection, the data flows back and forth remarkably smartly.

To get the best out of the system, you need to separate the bands, but once you've done that, devices connect faster and work more reliably.

Using a laptop, I was able to file transfer from a wired server at 70MB/s in the same room and at least 25MB/s in the adjacent one. As the best performance I get out of Infinity 2 is roughly 50Mbits, then wirelessly connected devices are limited in the house by that and not the Smart Hub when accessing the internet.

The cost I quoted is an RRP, so very few people will actually be paying that for the Smart Hub. New Infinity customers will get it for free, as will those who agree to restart their contracts. Existing Infinity customers who don't wish to do that can pay £50 to get one. Even at £50, it could be money well spent if it avoids the need to install and power a wi-fi extender for full coverage.

There are faster routers with even greater range available, but they're likely to cost you much more than this. For anyone still with the Home Hub 3 or 4 that is sticking with BT, this is a no-brainer, though there isn't any guarantee that it will fix your wi-fi woes, depending on their nature.

mm **Mark Pickavance**

A vast improvement on previous BT routers

Acer Chromebook R11 CB5-132T

Acer's new R11 is built for the future of Chrome OS

DETAILS
- Price: £189.99
- Manufacturer: Acer
- Website: www.acer.com
- Requirements: Wi-fi broadband connection

Chromebooks can be something of a culture shock for those who have used Windows for a long time, as the Chrome OS is essentially just a browser. If that's your thinking, then consider how much of your working day you spend in a browser using web-based applications and sites. And hopefully, it will start to make much more sense. And after a few hours with the new Acer Chromebook R11, you might just be convinced to ditch Windows and walk Google's alternative path.

On paper at least, the R11 is a rather well-specified netbook. Built around the Intel Celeron N3060 dual-core CPU that runs at 1.6GHz boosting to 2.48GHz, it features 4GB of RAM and 32GB of eMMC storage. If you need more space to store things locally, it has an SD card slot, though the remit of this device it to operate in conjunction with the cloud and its file services.

The screen is a razor sharp IPS display with a natural resolution of 1366 x 768 – more than enough pixels for the 11.6" panel to present comfortably. There's a reasonable sized keyboard, generously scaled touchpad and the usual selection of USB (two, and one is USB 3.0!) ports along with HDMI.

Key R11 Features
- Chrome OS.
- Intel Celeron N3060 dual-core 1.60GHz.
- 11.6" 16:9 IPS HD touchscreen (1366 x 768).
- 360° Acer dual-torque hinge.
- 4 GB RAM, LPDDR3 and 32GB eMMC storage.
- Up to 12 hours battery life.
- Patterned aluminium cover.

"An excellent Chromebook that really sells Google's Chrome OS vision"

For this sort of money, that's mostly what I'd have expected. What I didn't really anticipate is that this system would have a touchscreen and a reversible hinge that allows it to enter tablet and tent modes, should you want to do that. That's a slightly odd choice in that the Chrome browser isn't exactly designed for direct finger control, even if it does work after a fashion. Or it would be if there wasn't a change coming to Chrome OS in the next major release that could make this both a replacement for previous Chromebooks and also Android tablets.

Yes, the Google Play store is coming to Chrome OS, and the R11 is one of the first machines that will be blessed

with the capability, once Google has ironed out the majority of bugs.

My problem as a reviewer is that I haven't experienced this machine running Android *Angry Birds* or that platform's version of Office 365. Regrettably, even on the beta or dev channels, it isn't released at the time of writing, though it might be along soon, I believe.

What it will be like is therefore an unknown quantity, even if this machine was built specifically with the intention of achieving this. On that basis, I can't in all conscience tell you to buy this because of what it might do in the future, only what it does do today.

The good news for Acer is that what it does now is pretty nice, without the Android app carrot being so tantalisingly dangled for us. There are two aspects to this design that really make it work so much better than many Windows-based netbooks that you'll see around the same price.

The first of these is how frugal the power consumption is under Chrome OS, where the manufacturer's quoted battery life of 12 hours isn't just pie in the sky. Using the typical suite of Google services and web surfing, the three-cell lithium-ion 3490mAh battery will get you through a full working day and have power left for some couch surfing later.

The second excellent choice that Acer made was to put 802.11ac wi-fi in the R11. Using Intel's Dual Band Wireless-AC 7265 puts the R11 on par with the wi-fi connectivity of many Ultrabooks and allows those with the latest router technology to get very snappy performance even when surfing rich locations or watching streamed HD video.

So how could it be even better? Well, the inclusion of glass on the screen for the touch functionality has increased the weight to 1.25kg, making it heavier than less ambitious designs. But the feature that's really beginning to grind with me is the needle thin proprietary power connectors that Acer (and others) love so much. Logically, this should be a USB Type-C connector, rather than this easily breakable and difficult to replace nonsense.

Even with the power connector silliness, this is an excellent Chromebook that really sells the practicality of Google's Chrome OS vision. Some people won't like the colour or the size of the screen or that you don't get Cherry MX switches on the keyboard. But for someone who wants a mobile platform that works well with the Google ecosystem, this is a hard act to beat.

mm Mark Pickavance

Terrific Chromebook with the potential to become a tablet, maybe

Humax FVP-4000T

Humax enters the arena of Freeview Play with a new set-top box

DETAILS
- **Price: £199.99 (500GB)**
- **Manufacturer: Humax**
- **Website: humaxdirect.com/uk**
- **Requirements: n.a.**

The FVP-4000T set-top box is the first venture into the arena of Freeway Play by Humax. This Humax box is supplied with a remote control and leads for mains power, Ethernet and HDMI connectivity. Similar in size and shape to the Humax HDR-1100S reviewed recently, apart from the faux leather look to the top of the box, it's available with either 500GB or 1TB of storage capacity, in a range of different colours.

Once set up, this Humax box offers a range of features that are accessible from the large style supplied remote control. By pressing the home button on the remote, a scrollable menu appears on the television screen, allowing you to switch between the TV guide, recordings, on demand, media centre and settings plus a Recent category, which appears once the box has been used to access content.

The EPG TV guide allows you to make full use of the three tuners built into the Humax box. Up to four programmes can be scheduled for recording simultaneously, while a fifth programme can be watched live. Programmes can be selected for recording on a one-off basis or as part of a series, with a choice of SD or HD broadcast when available. Recorded content will be stored on the unit's internal hard drive, providing up to 300 hours of programmes, and then made available from the Recordings option for viewing later.

> **"Content was not detected, even though it had been accessed earlier"**

Providing catch-up television is the main function of the on-demand feature of this box. You can select from BBC iPlayer, ITV Player, All 4 and Demand 4 services for your fix of missed programmes. This section also contains links for items that include YouTube, Euronews and internet radio.

The media centre, as you might expect, handles your personal collection of music, videos and photos. Some of this content could be stored on an external device, such as a flash stick or hard drive, which is then linked to the Humax box via a USB port on the right side of the device. As soon as a device is connected to this port, a message will appear on the television's screen announcing its arrival and offering a choice of music, video or photo content. You can then access the content you want. Generally, this process was trouble-free, but on a couple of occasions content was not detected, even though it had been accessed from this source during an earlier session and was still available from the Recent option. I have not got to the bottom of this anomaly.

The media centre can also be used to access appropriate content stored on your local network. According to the user guide supplied with this product, you're meant to be able to access the Humax internal hard drive from a computer on the same network. However, whenever I tried to do this, I received a message that the drive was not accessible, as I did not have the required permission to use this resource.

Unfortunately, such problems prevent the FVP-4000T from being something that I can recommend. It's also not particularly cheap either.

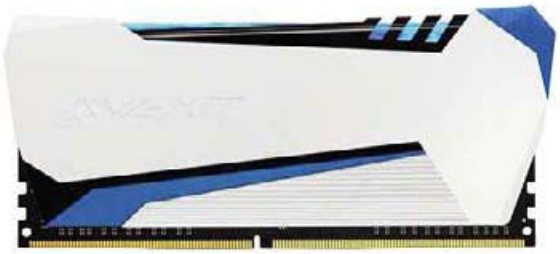
mm Michael Fereday

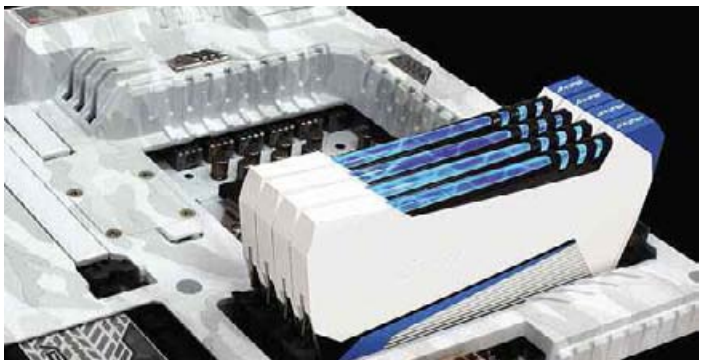
Some useful features but one or two worrying problems

Avexir Raiden 8GB (2x4GB) 2666MHz DDR4 Memory

Prepare for the power of the god of lightening to visit your PC

DETAILS
- **Price: £68.91 (Ebuyer)**
- **Manufacturer: Avexir**
- **Website: www.avexir.com**
- **Requirements: System that accepts 288-pin DDR4 models with a speed rating of PC4 21300**





In the 30 or more years I've been doing this gig, I've seen some funky memory modules. But the Raiden Series by Avexir eclipses them all for visual splendour that makes those with colour LEDs appear understated and passé.

But before I get to the Raiden's party trick, what we've got here are two 4GB DDR modules of PC4 21300 spec (2666MHz) with CL15 (15-15-15-35) speed rating and which can handle up to 1.35 volts. The standard voltage for 2133MHz JEDEC profile is 1.2V, but Avexir quotes 1.35V as the limit for those who want to get to the very bottom of the bandwidth barrel.

The SPD table includes just three JEDEC options for 853, 995 and 1066MHz that double under DDR4 to 1706, 1990 and 2133MHz. As is typical with memory, the lower clock speeds do offer tight timings, with the 1706MHz option offering 12.0-12-12-12-29-41. But for the majority of users the best choice will be the single XMP profile on offer, offering a 2666MHz clock and reasonable 15.0-15-15—35-52 timings. These are pretty good and with a bit of extra voltage you might be able to lock them down a bit more.

That specification roughly matches them with products in the HyperX Savage range and Corsair Vengeance LPX, though these modules are between 50% and 100% more for a kit of two 8GB DIMMs of 2666MHz DDR4. Those with a limited budget therefore might have to make the choice between a 16GB (2x8GB) kit or these with just 8GB.

However, what none of these modules do is put on a light show that looks like something from a well-budgeted Frankenstein movie. The clue, for fans of truly awful game-to-movie conversions is in the name because, played by Christopher Lambert or not, Raiden was the *Mortal Kombat* character who brought the lightning.

What Avexir has done is mounted some glass tubes along the dorsal edge of the modules and then used a high voltage converter to fill them with what appears to be blue electricity. It dances around the tube in a mesmerising fashion, though I don't notice any continuity with what the PC might be doing at all.

For these to be appreciated, you either need an open plan case or a clear panel in the door.

Many people will wonder why, but others will have seen these promoted and have already planned some incredible steampunk-themed PC in which these will be the centrepiece.

I'm probably on the side of those that see these as good-quality memory that is somewhat overpriced, but I can't help admiring the ingenuity of a company that could create something so incredibly wacky.

My only concern is that at 6.3cm high, purchasers need to be mindful of clearances around the CPU cooler if they intend to deploy this electric boogaloo in their PCs.

mm Mark Pickavance

Features
- Dynamic Raiden blue LED.
- 8GB dual-channel kit (2 x 4GB).
- DDR4 2666 (PC4 21300).
- Timing: 15-15-15-35.
- Voltage: 1.2V.

Good memory and great lighting effects

GROUP TEST

Mid-tower PC Cases

There are plenty of PC cases available these days, from the tiniest palm-sized chassis to things that look like the monolith from *2001: A Space Odyssey*.

However, we've got six mid-towers to sample this week to see which manage to combine all the good stuff you want from a modern PC case.

Mid-tower PC Cases

Cooler Master Elite 430

DETAILS
- **Price: £45**
- **Manufacturer: Cooler Master**
- **Website: goo.gl/QsEvVN**
- **Requirements: Standard ATX PSU, mATX, ATX motherboard**

The Cooler Master Elite 430 is a good mid-tower case

There's enough room within for upgraded components, but it misses out on some extra features

The Cooler Master brand is certainly no stranger to the pages of Micro Mart. The company's cooling, power supply and peripherals are considered some of the best available, offering a good mix of both price and quality.

However, it's the company's range of mid-tower cases that interests us today. The Cooler Master Elite 430 can be found toward the upper end of the mid-tower series and measures 190 x 424 x 490mm with a mixture of steel and ABS plastic. It's an ATX/micro-ATX case that offers seven PCI expansion slots, three 5.25" bays and seven 3.5" drive bays. The PSU is bottom-mounted, and there's adequate room for more fans beyond the pre-installed 120mm front fan.

Internally, the Elite 430 has room for a 315mm graphics card and can accommodate CPU heights of up to 163mm. There's a reasonable element of cable management present in the void behind the motherboard backplate, but it does lack some of the cable exit slots we've become used to seeing in many mid-tower units.

The design certainly looks good, with a front section that angles out slightly and covered in a see-through grill exposing the red LED front-mounted fan. From midway up the front of the tower, it flattens out and houses the three front 5.25" drive bays. There's also a pair of legacy 3.25" panels located under the bigger drive bays. At the top you'll find a couple of USB ports (one of which is 3.0), and the headphone and microphone port. The power and reset, along with the activity LEDs, are located either side of the 3.25" drive bays.

The side windowed panel reveals a fair amount of the internal build, and there's a vented section with screw points for fitting a side fan.

The case is robust enough, without any noticeable flimsy sections. There could be a few more extras to help raise the score a little, such as rubberised grommets for liquid cooling (there are a couple of metal push-points), better cable management and perhaps another included fan to help entice buyers. For the most part, though, it's a pretty decent case.

Other than that, there's not much else to report on. On its own, the Cooler Master Elite 430 is a good case: it's got more than enough internal space to fit a decent graphics card, there are some good cooling points available, and it's reasonably cheap at just £345. But on the other hand, there could have been so much more added to help pitch it better, and considering it's toward the top of the mid-tower range, we were expecting more.

Deepcool Landking v2

DETAILS
- Price: £40
- Manufacturer: Deepcool
- Website: goo.gl/5KpKzU
- Requirements: ATX PSU, ATX, micro, mini-ATX motherboards

The Deepcool Landking v2 measures 512 x 218 x 515mm and is made up from a mixture of plastic and steel, with 0.5mm thick panels. There are eight PCI expansion slots available (with support for four GPUs in SLI/CrossFire mode), a bottom-mounted PSU and ten drive bays (broken down to three 5.25", five 3.5" and two 2.5" bays).

Internally, there's plenty of room available, with 280mm clearance for longer graphics cards and clearance for 168mm CPU coolers. And as a good addition, there are also a number of cable management channels and exit points placed behind the motherboard backplate and feeding out to various sections of the case.

The design is quite imposing, with a futuristic, gun-metal grey colouring throughout. The front of the case is made up of the three 5.25" drive bay panels, with a mesh section at the bottom, which hides one of the pre-installed 120mm fans.

Along the top there are USB 2.0 and 3.0 ports, along with the front audio ports. In addition to the ports and this is the bit we really like about the Deepcool Landking: there's a slide away section at the front/top, which reveals a further two USB 2.0 ports and a SATA hard drive hot plug port. This section is angled too, so the drive sits comfortably against the angle of the bay and slots perfectly into the port located at the base of the section. It's quite an ingenious design.

The Deepcool Landking is a mid-tower case brimming with features and extras

> **"The design works well, and there's some scope for upgrading"**

The side panel has a large windowed section to show off the internal specification of the build, including the single pre-installed rear 120mm blue LED fan. Further to the rear fan, Deepcool has also opted to pre-install a single 120mm front fan and a pair of 120mm top-mounted fans. That's quite an impressive number of default fans.

Despite the size of the chassis, the Deepcool Landking v2 feels surprisingly compact. There are plenty of great features in this case,

The built-in SATA port is a stroke of genius

and while it may look a little different to the usual mid-tower design, it works really well.

We quite liked the Deepcool Landking v2. It looks good, there are plenty of cooling options, the design works well, and there's some scope for upgrading, especially in terms of the multiple graphics cards. And we simply can't get enough of that SATA hot-swap port.

What's more, the Deepcool Landking v2 is priced at just £40, which is pretty impressive considering what you get.

Game Max Falcon

DETAILS
- Price: £35
- Manufacturer: Game Max
- Website: goo.gl/PHFtOA
- Requirements: Atandard ATX PSU, ATX, micro and mini-ATX motherboard support

The Falcon case, from Game Max, is a fantastic-looking item that comes in three different versions – blue, green and red – with each representing the colours of the pre-installed LED fans.

The Game Max Falcon is a pretty neat case to build your future system in. This mid-tower measures 202 x 505 x 473mm, and features seven PCI expansion slots, two 5.25" drive bays, two 3.5" bays and three 2.5" bays. The PSU is mounted at the bottom of the case, and there are a couple of grommets available at the back for a liquid cooling solution.

The front of the case is almost a solid ventilated section, with at least three quarters of the front of the case being used to vent in air from the included two 120mm LED fans, and the last quarter of the front is taken up with the removable drive bay panels. The top of the case features a pair of USB 3.0 and 2.0 ports, along with power, activity LEDs and the microphone and headphones ports. There are also a couple of fan speed controller switches and a magnetic removable filter that covers the optional top-mounted fans.

Cable management is adequate enough, with plenty of entry and exit sections cut out from the motherboard backplate. The cut-out sections are slightly rounded off too, so they're not as sharp as some other examples we've seen in the past.

The Game Max Falcon is certainly a stylish-looking mid-tower case

There's a good mix of features and extras that will appeal to system builders

The drive bays feature removable plastic trays for both SSD-sized drives and more conventional 3.5" hard drives. There's enough room to house a 415mm graphic card and clearance for 161mm CPU coolers. Also, thanks to the decent cable management, you should be able to get clear airflow over the motherboard and its components.

Speaking of air flow, there's room to fit another three 120mm fans within the case.

The Game Max Falcon is a pretty impressive looking case with its green LEDs and large side panel window. If you include some internal LEDs in your build, you can get the system looking quite spectacular; if not, then you're still in for a treat with the included front LEDs.

We liked working with the Game Max Falcon. It looks great, has plenty of room inside for everything we needed, and there's ample room to expand. Best of all is the fact that it costs just £35.

NZXT Phantom 410

DETAILS
- Price: £75
- Manufacturer: NZXT
- Website: goo.gl/MsX5zM
- Requirements: Standard ATX PSU, ATX, micro and mini-ITX motherboard support

If it's eye-catching style with sleek lines and an impressive-looking LED lit interior you're after, in your PC case, then NZXT has the answer for you, in the form of the Phantom 410.

This is a mid-tower chassis that's lean, with angled sections across the front and over the top of the case – not quite centre, but slightly off and sweeping over a windowed section on the top, while moving to the opposite side toward the bottom, where a mesh air intake sits.

The Phantom comes in a variety of colours: white, black, red, white with blue stripe, black with orange stripes, gunmetal, and black with white stripes. It may seem like a crazy collection of hues, but they work well.

It measures a satisfyingly large 215 x 516 x 532mm and weighs 9kg. Inside, you'll find three 5.25" drive bays and six 3.5" drive bay slots, all of which are tool-free and set out in a rail design for easy access and removal.

The included fans consist of a front 120mm unit, a rear 120mm fan and a single top fan measuring 140mm. However, you can optionally install a pair of 120mm fans at the front, another 120mm fan to the side, two 140mm fans along the top, and finally another single 120mm fan on the bottom of the case. These can be swapped out for single 140mm fans if needed.

The impressive chassis of the NZXT Phantom

Inside there's plenty of room, and the quality is excellent

There are some pretty neat features in the Phantom. For one, the right-hand panel offers easy access to the 3.5" drive bays, rubberised cable holes, loads of cable tie areas and a decent large cut-out section for the custom cooling solution.

The rear of the chassis offers seven expansion slots, a couple of grommets for passing a water cooling solution through, and a section on the base where the PSU is fitted. Likewise, the underside of the case has a mesh dust cover over the PSU fan and further mesh sections for cooling and the aforementioned fan. Plus the entire case sits on a set of rubber feet to cut down noise and vibration.

The only downside to this rather excellent case is the fairly weak front door that pops out and swings to the left to reveal the 5.25" drive bays. While okay, it does feel a little flimsy considering the level of quality throughout the rest of the case. However, in this day and age, how often do we access the optical drive?

There are plenty of sections along the inner rims of the case to fit an LED strip, and the windowed areas provide easy viewing for the light show some system builders insist on fitting. Overall, it makes for a pretty spectacular looking case.

As we said, the quality of the NZXT Phantom 410 is astounding. It has been machined to near perfection, and regardless of the colour scheme, the case looks truly wonderful.

Xenta B138A

DETAILS
- Price: £22.98
- Manufacturer: Xenta
- Website: goo.gl/eSRuPC
- Requirements: Standard ATX PSU, micro ATX motherboards

▲ *The Xenta B138A looks okay, but it lacks features*

➤ *The design isn't great, but the low cost will appeal*

The component maker Xenta produces a range of cases, and they may at first seem a little basic, but they're actually quite impressive for a number of reasons.

The one we have to test in this instance is the Xenta B138A. This is a general mid-tower case that measures 195 x 410 x 423mm and features a vented side panel, with a slight view of the interior, seven expansion slots, a PSU section at the top, a flip-down optical drive cover and room for eight drive bays.

The exterior is neatly finished with a mixture of both plastic and steel and some splashes of red plastic where you'd mount a front fan. The brushed aluminium effect is quite pleasing to the eye, and considering this is a no-so-well-known case, it's reasonably well built and not too flimsy.

The interior can feel a little cramped, though. There's enough space for mATX boards and components, but anything bigger (including some graphics cards), and you'll soon begin to notice the lack of space. This also makes cable management a bit of a chore, and there are no dedicated cable channels to hide the slack from view or from getting in the way of other components; just a very small void behind the motherboard backplate. To be fair, though, that's a feature you'd normally find on a more expensive case, so we'll let it pass.

It does, however, offer a side-mounted SD card reader, USB 2.0 and 3.0 ports along the top-front, as well as power and reset. And the case does have the option to install a couple of 120mm fans as well as a rear 80mm fan, but sadly none were supplied.

> **"One thing that did bug us somewhat was the optical drive flip-down cover"**

One thing that did bug us somewhat was the optical drive flip-down cover. There's a slight lip on the underside of the flap that catches the optical tray as it opens. The Blu-ray drive we used is a fairly generic model, and if we were inclined to do so, we could have easily filed off a little of the plastic on the flap to stop the catching. Furthermore, the eject button for the optical drive is mounted to the side, which we feel is a little awkward to get to.

There's also an odd choice of internal 5.25" drive bays – far too many considering there's only one option to have an optical drive in use. We feel that better use of hard drive bays or maybe a couple more 2.5" or SSD bays would have been a better design choice.

Overall, the Xenta B138A isn't a bad PC case; there are just a few design oddities and omissions associated with it. The blessing here, though, is the remarkably low price of £22.98.

If you're looking to build a budget system, one that looks reasonably good, and you're not too concerned over the aesthetics, then the Xenta B138A may well be an apt choice. But it lacks too much for a higher-grade system build.

BeQuiet Silent Base 800

DETAILS
- Price: £99
- Manufacturer: BeQuiet
- Website: goo.gl/4J1rvc
- Requirements: Standard ATX PSU, ATX, micro and mini-ITX motherboard support

There's a fine balance between practicality, upgrade potential, cooling performance and noise reduction when it comes to choosing the right case. The cases we've looked at so far do a good job of combining all these factors, but this example from BeQuiet may well leave all others behind.

The BeQuiet Silent Base 800 is an interestingly designed chassis. While it doesn't opt for the dazzling splendour of multiple LEDs and windowed side panels, it still looks pretty good. It has a sense of minimalism about it, with a hint of colour depending on the whether you opt for the orange-and-black version (with a rusty orange trim around the front and sections of the interior) or the silver trim model. It's a design that works well, and it's quite understated and elegant.

This mid-tower case measures 266 x 559 x 495mm and weighs a hefty 9.4kg. It has room for three 5.25" drive bays and seven 3.5" drive bay slots. The included cooling solution comes in the form of two front 140mm Pure Wings 2 fans and a 120mm rear Pure Wings 2 fan. The Pure Wings 2 fans offer a maximum speed of 1500rpm, while only issuing around 18dB(A) in terms of the noise levels. There's also room for a pair of 140mm top-mounted fans, a single 120mm side fan and a single 140mm bottom-mounted fan.

The orange-and-black look of the BeQuiet Silent Base 800 is minimalist but good

There's lots going on with this case, but it's rather expensive

The build quality of the BeQuiet Silent Base 800 is excellent. The covers are manufactured from ABS plastic, with steel side panels and plenty of rubberised pads throughout and along the raised and removable pair of skids that make up the base stand. The top features a large power button, slightly indented in the centre, with two pairs of USB 3.0 and USB 2.0 ports, alongside headphone and microphone jacks.

The rear of the case has seven expansion slots, three cooling grommets, plenty of mesh sections for the fan, a section for the PSU to fit at the bottom of the case and a slide-out dust filter under the PSU section.

Inside the case the first thing you'll notice is the sound dampening material covering the entire inner section of the side panel, with a square area cut out for placing a fan. There are plenty of colour coded rubber cable sections, along with similarly coloured silicone 3.5" drive slot rails – again to cut down noise levels and vibration.

Throughout the interior there are foam pads where the PSU, drives and raised spacers for the motherboard are fitted. This cuts down on noise levels considerably, while raising the levels of the component parts slightly for somewhat better cooling, even if it is only a few millimetres.

The overall effect, though, is superb, and it's exceptionally quiet, even with the side panel removed. BeQuiet has done a fantastic job with the Silent Base 800, but this level of design comes at a hefty £99, making this the most expensive case in the group.

Deepcool Landking v2

The Deepcool Lankdking v2 hit the perfect spot with price, features and design. There's a lot to like about this mid-tower case, especially its built-in SATA dock port.

Game Max Falcon

We were quite surprised at just how good the Game Max Falcon was. We initially thought it would be a sub-standard case from a little-known manufacturer. Thankfully, we were glad to be proved wrong.

For just £35, there's plenty to like about this case, in addition to its fantastic price.

How We Tested

Each case was fitted with a Gigabyte Z87M-DS3H, Intel i7-4790K, 16GB of memory, a GTX 970 GPU (where possible), a 700W PSU, 128GB SSD and a further 2TB hard drive. We used stock cooling for the CPU and whatever case fans came with the system.

	Cooler Master Elite 430	Deepcool Landking v2	Game Max Falcon	NZXT Phantom 410	Xenta B138A	BeQuiet Silent Base 800
Price	£45	£40	£35	£75	£14.99	£99
Dimensions	190 x 424 x 490mm	218 x 512 x 515mm	202 x 505 x 473mm	215 x 516 x 532mm	195 x 410 x 423mm	266 x 559 x495
Weight	4.7kg	6.6kg	6.2kg	9kg	6.2kg	9.4kg
Included Fans	1x120mm	4x120mm	2x120mm	2x120mm, 1x140mm	None supplied	2x140mm, 1x120mm
No 5.25" Bays	3	3	2	3	4	3
No 3.5" Bays	7	5	2	6	2	7
No 2.5" Bays	0	2	3	0	2	4
Expansion Slots	7	8	7	7	7	7

Top 5 Tech Days Out

XXX

1 Bletchley Park

Without doubt, the home of British codebreaking, Bletchley Park was instrumental in the fight against the Nazis in World War II. Famously, it was here that the Allies managed to crack the Enigma cypher, used by the Germans to send encrypted messages. Notably, Alan Turing was a key member of this team.

These days, the site, based in Milton Keynes, is open to the public from 9.30 to 17.00 during summer and till 16.00 during the winter. Online tickets cost £16 for adults, £9 for children aged 12 or older, and £14 for OAPs and students. It's a little more expensive on the door, but if you're remotely interested in the history of information technology, it's worth every penny.

2 London Science Museum

Located a stone's throw from South Kensington tube station, this museum has been a major tourist attraction since it opened in 1857. Of course, technology has changed a great deal over that time, and much of that progress is charted within the walls of this great establishment. But it always has an eye on the future too, and if you want to spend a day being amazed by the ongoing ingenuity of humankind, there are few better places to visit.

The on-site IMAX theatre, the flight simulators and some special exhibitions charge a fee, but entrance to the museum is free. If you can afford it, though, do make a contribution, so the museum's great work can continue.

3 Leicester Retro Computer Museum

Open on most Sundays, this is a must for fans of old computers who find themselves in or around Leicester. Run entirely by volunteers, it's open from 11.00 to 17.30, but it's worth checking the website at **www.retrocomputermuseum.co.uk/index.php** before paying a visit, because there are a few weeks when it's shut.

Provided it's open, you'll find computers and consoles from way back to the 1960s. Whether it's well-known consoles like the SNES or less popular systems such as the MTX512, there's plenty to look at and plenty to do.

4 Museum Of The History Of Science, Technology And Medicine (HSTM)

If you happen to be in the neighbourhood of the University of Leeds, then you could do a lot worse than visit this attraction, which was established by students and staff. With collections housed across the campus, there's a wide range of artefacts, which provide a fascinating glimpse into the scientific past of this educational establishment.

The museum is run by volunteers, and it's always on the hunt for more, so instead of just paying a visit, you might actually become a more permanent fixture. To find out more, head to **goo.gl/kSh7p8**.

5 Science On The Streets

TLet's head north of the border now for a fantastic day out in Glasgow. "Failte gu science air sraidean Ghlaschu!" it says on the Science on the Streets website (**goo.gl/rqUNtU**), which Google Translate tells us means "Welcome to science on the streets of Glasgow". And welcome you will be, with these free walking tours around scientific places on interest in this historic Scottish city.

There are two tours available, each taking a different route to the other, but they both last around 90 minutes each. To book a spot, drop an email to **tours@scienceonstreets.org.uk**. mm

Source http://www.flickr.com/photos/draco2008/2246636931

RefurbiPhones.co.uk

How To Make More Room On Your Phone

Rob Leane explores the easy things you can do to free up space on your Android or iOS phone...

That moment when your phone screen lights up to tell you that you've run out of storage space is one of the most frustrating things about owning a mobile, especially if you're paying through the nose for a snazzy handset. When you've got more stuff than your phone can handle, it's very tempting to lob the useless little brick at the wall.

But before you try that, here are a few things you could do to free up some space...

The Easy Stuff

Regardless of what kind of phone you have, some housekeeping can go a long way to making more storage space. Delete any apps that you don't use. Clear every cache that you can (instructions for your specific phone and browser should be findable online). Move any particularly large videos or image off of your phone's camera roll and onto your PC. You may need to use a cable to do this, or you may be able to

RefurbiPhones.co.uk

email the space-hogging files to yourself. If there isn't room on your computer either, try a hard drive.

If you have movies, music and/or podcast downloads on your phone, consider moving them onto an iPod or other media-playing device (if you have one). MP4s and MP3s are some of the biggest offenders when it comes to taking up space. Clearing them out should make loads of extra room. The same goes for e-books. And deleting old messages and notes can clear out a little space too.

In the settings of most phones, you'll be able to see a breakdown of which apps are using the most space. This can be enlightening. If you find something taking up what you think is a disproportionate amount of space, investigate ways to crack down. For example, WhatsApp allows you to send entire conversation logs (including media) to your PC via email, allowing you to delete the original and clear some space on your phone.

Embrace the cloud

If you haven't done so already, now is the time to embrace the cloud. As scary and mystical as it may sound, cloud storage allows you to keep a lot of your files in the online realm instead of clogging up your phone with them. This can really turn the tide in your favour if you're fed up of those 'you've run out of space' reminders.

Many cloud services offer a reasonable amount of storage free of charge. Apple's iCloud, for example, gives you a free 5GB to start you off. This could be enough to house your whole image collection, meaning the photos you snap on your mobile needn't take up loads of room on there. And if 5GB isn't enough for your particular needs, it's only a few quid a month to get more. (At the moment, you could get 1TB of space for £6.99 a month.)

At the risk of sounding like an advert for cloud storage, it's worth stressing here that there are other benefits to the cloud. Syncing multiple devices has come in particularly handy for me, meaning that all my photos go straight to my laptop without me needing to bother locating the right cable in a very messy drawer.

But still, if you're reading this, there's a strong chance you know a fair bit about the cloud already. Let's move onto the more complex stuff...

The Complex Stuff

You'll notice that there are loads of apps on your phone that you didn't choose to download. These free apps that come with the phone are nicknamed 'bloatware' because of the excessive amount of space they take up even though you never asked for them in the first place. Every time you get a new phone there seems to be more and more of these. ('Health' and 'Stocks' are two that I've literally never used. Thanks, Apple!)

In an ideal world, it would easy to remove these bloatware apps. But that's not the world we live in at the moment. Apple's upcoming iPhone operating system iOS 10 will allow users to delete rather a lot of bloatware, but it isn't out yet. (An unfinished version is available online, but is quite glitchy.)

While we wait for that, if you want to delete your bloatware you'll need to get technical. There are plenty of online tutorials about 'jailbreaking' your iPhone, but these are arguably too dangerous to bother with. Apple has previously stated that hacking your iPhone's locked settings could create security issues, so we can't fully recommend this.

For Android users, an app called System App Remover can help you hack your phone and delete those unwanted preinstalled apps. Again, though, doing this could create other problems on your phone. Giving your phone a truly thorough clear-out is definitely the safest thing to do, then, and there is one other option...

Your Last Option

Sometimes there just doesn't seem to be a way to make more space on your phone. You've deleted absolutely every non-essential app. Your pictures are all on the cloud. Your songs, films, podcasts and e-books are all rehoused on other devices. You've emptied out the unnecessary data being held in your essential apps. All caches are cleared. But still, up comes that infuriating message saying you've run out of space.

Stop right there. Lower you arm. Do not throw your phone at the nearest wall just yet. There's one other option still remaining, which could prove that unshakeable theory that's been niggling away at the back of your brain this whole time: maybe the phone is the problem, not the way you use it.

> **"Regardless of what kind of phone you have, some housekeeping can go a long way to making more storage space"**

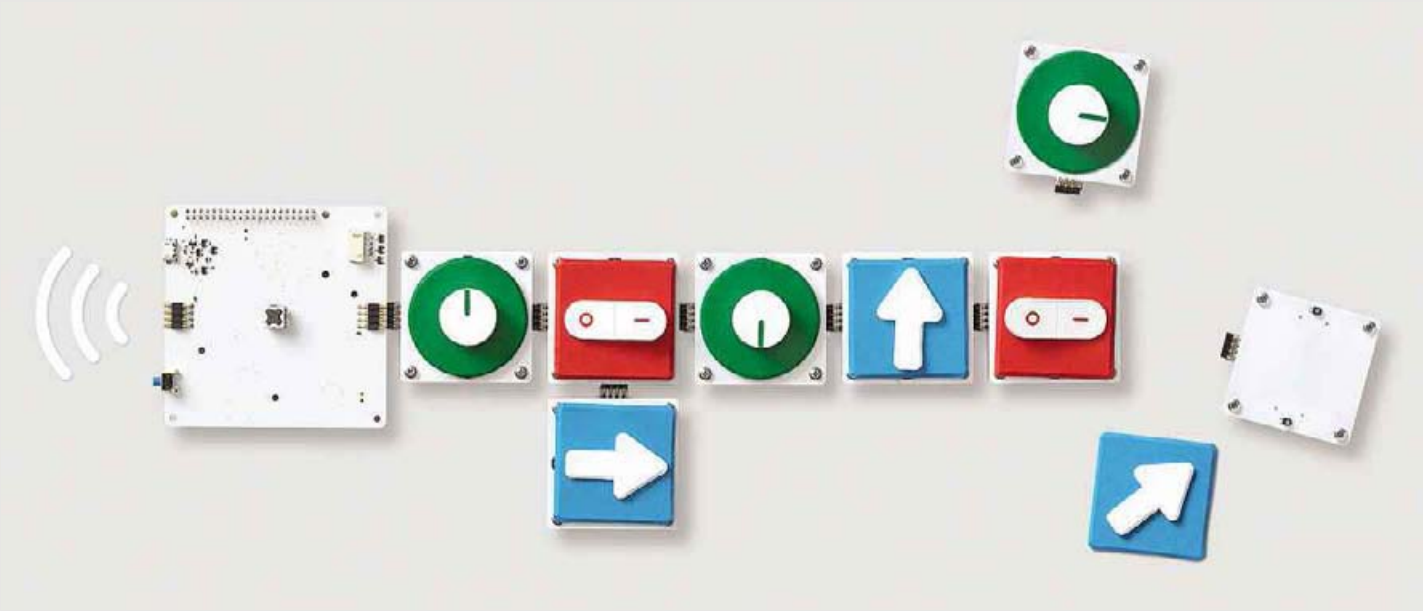
I reached this stage with my iPhone last month. All my photos were on the cloud, and I had deleted pretty much every conversation I'd ever had across texts and WhatsApp. All I'd ever really downloaded onto this phone were podcasts, and I'd deleted all of those. Facebook and Twitter were gone. I was even using Safari as my main browser. Things had got that bad. And yet I still couldn't take a photo because the phone said I had no storage.

I checked in my settings. Apple's built-in Podcast app was still taking up loads of space, retaining 'Documents & Data' that there was no way to delete, even though I had removed all the downloaded materials from the app. That couldn't be right, I thought. It must be some sort of glitch.

At the end of my technological tether, and safe in the knowledge that I'd backed up all the important stuff on my laptop, I performed a factory reset. This was my last stand against my phone's storage limitations before lobbing the thing at the wall became the last option available. Thankfully, it worked.

I really wish I'd thought of this sooner. I have loads of apps again now, and don't have to use Safari. I've started using a different podcast app (Overcast, it's called), and I haven't had a single storage problem since.

So if you've tried everything to free up space on your phone, and the device still isn't cooperating, back up your important stuff and try a factory reset. It could be a problem with the phone, not your files. **mm**



Project Bloks

Roland Waddilove looks at Google's new tangible programming idea to create a new generation of coders

A shortage of programmers and an increasing need for them has led people to think about the ways in which we can encourage more children to take up programming. We need a new generation of coders, developers and bright young minds to develop the next generation of computers, devices and software. The problem is that coding is a dull intellectual subject that is not particularly interesting or exciting for children, but Google thinks it has the answer, and the company calls it Project Bloks (**projectbloks.withgoogle.com**).

There has been a lot of interest in getting children to learn at least the basics of programming, because it's so widespread in everyday life, and there's so much demand. Programming code drives everything, including our computers, phones, tablets, TVs, set-top boxes, and the whole Internet of Things, which is massive. It will even drive our cars one day.

Coding isn't an activity that children naturally engage in, so it's difficult to get them started. Children like to play with physical objects in the real world and not concepts and algorithms in their heads. Give them a set of wooden blocks, and they will build something; give them Lego, and they will

spend hours snapping the bricks together to build all sorts of things, which stimulates their imagination.

Now suppose those blocks that they play with could contain electronics and sensors, and when they're joined together they perform some function or action. That is the idea of Google's Project Bloks, which consists of electronic modules that can be snapped together to create devices that perform functions. For example, they could measure the temperature and turn on a light when it's cold.

Playing With Turtles

This is called tangible computing or tangible programming, and instead of coding on a computer, children play with blocks on a table. It's a graspable user interface that can be picked up and manipulated in the hands.

Google is not the first company to come up with this idea. There have been many attempts to make programming more interesting and real for children, and the ideas date back decades to Seymour Papert and the Logo programming language decades ago. Logo includes turtle graphics, which enables you to program a turtle, usually represented by a triangle-shaped object on the computer screen. You can tell it to 'forward 10' to move forward 10 units, 'right 90' to turn right 90 degrees, and so on. Using simple commands like these, you can create drawings, shapes and diagrams, because the turtle leaves a visible trail behind it.

The turtle was sometimes made into a physical turtle-shaped object that could trundle around the floor, although it was usually attached to the computer by a long cable to carry the electrical signals, so it could not go far. It could be made to negotiate a maze with a series of commands or, if a pen was attached to the turtle, it could draw shapes on paper on the floor. There were even 'pen up' and 'pen down' commands to start and stop drawing.

The idea was that children would find it fun and challenging getting the turtle to move around and follow a list of simple commands they gave it. It was programming, but it was hands-on and interactive, and commands could be acted on as soon as they were entered. Children found a real physical turtle that could be moved around fascinating and loved writing programs for it.

▲ *Go to the BBC website and program the on-screen turtle with Logo (bbc.in/29PrstV)*

Blockly Programming

Blockly (developers.google.com/blockly) is another Google project that aims to encourage children to become programmers, and in some ways it's like Project Bloks, except that everything is carried out on your computer screen.

Blockly is an editor that is aimed at developers and educators rather than end users. People who are creating programming courses for children can incorporate the Blockly editor into their web or Android app. This enables drag-and-drop programming without having to type in any code or remember commands and syntax.

Programming with Blockly is like Project Bloks, and there are blocks on the screen that perform functions, such as move forward, turn left or right and so on. To create a program in the editor, you drag code blocks and snap them together. You can see how Blockly has influenced Project Bloks and both use code blocks that snap together.

There are examples of Blockly type programming resources at **studio.code.org**, and you can try the courses yourself. No programming knowledge is needed to get started, and you can work through the lessons in minutes.

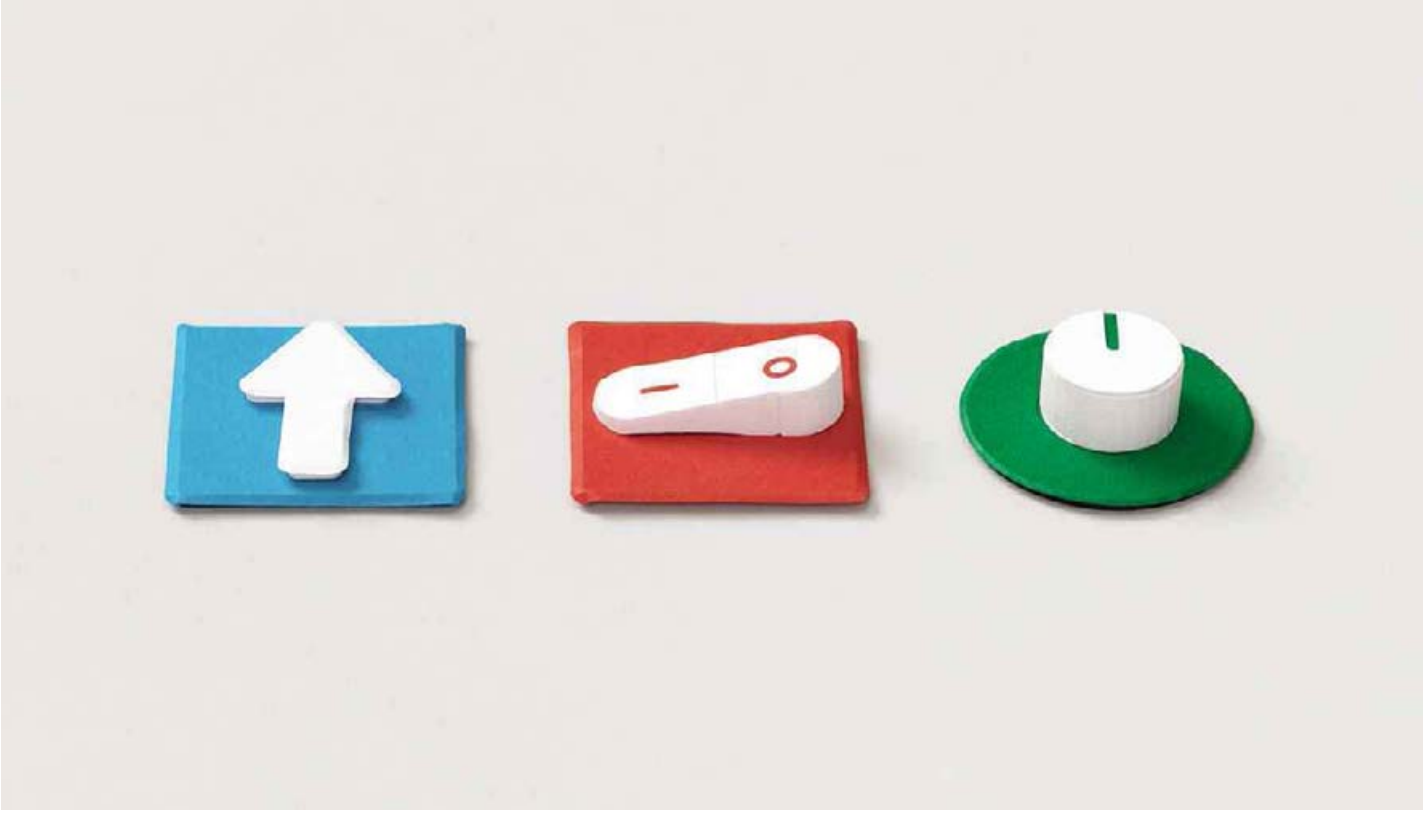
▲ *Programming can be simplified to snapping together coloured blocks with Blockly*

Algoblocks

The idea of making programming real, such as with a physical turtle moving around the floor led to an even more hands-on approach to programming. An inspiration for Google's Project Bloks was Algoblocks, one of the first systems to be called tangible programming, which was developed over 16 years ago.

It consisted of a collection of large blocks around 15cm^2. Each of the blocks had a function, and blocks could be joined together, eventually connecting to a computer. The result of putting the blocks together was a set of instructions, basically a simple program, which enabled a submarine on the computer screen to move around and navigate through an underwater maze.

Children were not aware they were programming, because they were simply placing blocks together on a table to make a submarine move. Being able to pick up, handle and place



Here are some examples of pucks, and the simple design makes their function obvious

blocks in any order appeals more to young minds than typing in lines of code on a keyboard. There are no syntax errors when snapping blocks together, you cannot make typing slips that result in bad commands, and you don't need to remember language functions and parameters. The blocks had symbols on them that indicated the action they performed, such as to move forward, turn and so on.

There were many variations of this, and some systems used blocks with no electronics at all – just blocks with colours or labels on them. The positions of all the blocks on a table was read by a webcam and turned into a set of instructions: in essence, a simple computer program that could then be executed.

Project Bloks

Programming is just too abstract, and it isn't the way that children learn. They don't learn by using abstract concepts on computer screens; they discover how things work by playing with objects in the real world, like toys. Give them Lego bricks, and they'll build towers, cars, planes and other things.

Project Bloks builds on the old Algoblocks idea, and it consists of an open hardware platform that enables developers, researchers and educators to build their own tangible programming kits. It isn't something that will be sold directly to the public by Google but is intended to be a resource for others to build on.

Google is developing the essentials, which include electronic boards and programmable pucks, which are basically small blocks that plug together to enable them to communicate with each other. Instructions can be passed from one to the other, and simple programs can be created to perform various functions or even to control external objects and devices, like a toy robot or car.

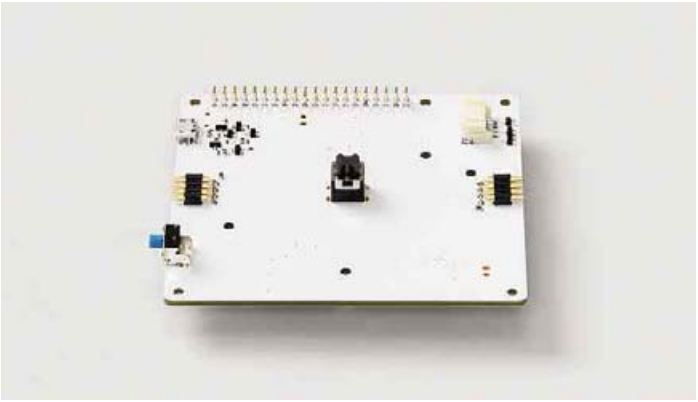
There are pucks, baseboards and a brain board. There are several different types of puck, which can perform actions like turning a switch on or off, playing music, turning left or right, jumping and so on. The shape and design of the puck is able to indicate their function; they can be a switch, a dial or knob, an arrow pointing in a direction and so on.

A puck is placed on a baseboard, which reads the instructions through a capacitive sensor. Several baseboards can be connected to each other in series, so you can have a set of pucks and baseboards joined, and the functions of each puck combine to create a simple computer program. Kids think they're playing with toys, but really they're learning the basics of coding and computation.

A brain board controls everything and is built on a Raspberry Pi Zero. This provides the power for the baseboards to operate; it reads their instructions, and it can connect to other devices through wi-fi or Bluetooth. For example, it could connect to phones, tablets, computers, robots, speakers or toys.

Project Bloks just deals with the internal electronics; it's up to others to design and build the external packaging.

Pucks are placed on a base board, and several can be connected together in chains



There is one brain board, which provides the power and wireless connections to devices

This is an example of the sensor lab using sensor pucks linked by base boards

The external form could be pretty much anything made from wood, plastic and other materials, so we could see a wide range of kits that look very different, but they all use Project Bloks internally.

Google's kit examples include a sensor lab where there are inputs and outputs. The input could come from a temperature sensor, and the output could turn a light on or off depending on the temperature. A music maker could enable you to input different instruments and then mix and loop them to produce a track, which is then outputted to a wireless speaker. A coding kit could be used to generate instructions for a wireless robot, telling it to move around and perform various actions.

The Next Generation

Will Project Bloks turn youngsters into programmers? Plugging blocks together to assemble small devices that perform various functions like playing music, measuring temperature or turning lights on and off is nothing like staring at a computer screen full of C++ code. There is little similarity, and no matter how much you play around with these gadgets, you won't learn a lot of real programming. However, some basic concepts can be learnt.

What Project Bloks and others like it will likely do is create a generation of makers and hackers. These are people that like building things and using existing technology in innovative ways. The logical step upward from tangible programming blocks and devices is the Raspberry Pi and all the amazing things you can make it do.

That device is a lot more complicated than a block; in fact, it's a mini computer, but it can be used in similar ways to tangible programming projects, and people are using them to create all manner of devices and gadgets. They do require real some programming, though, so typing and editing code on a screen may be necessary.

If you want to get your child interested and excited about technology and how it can be built and used, Project Bloks and other tangible programming kits are great. They stimulate an interest in the physical world rather than the intellectual challenge of coding, obscure commands and syntax. **mm**

Scratch Programming

Other influences on Google's Project Bloks include Scratch (scratch.mit.edu) and ScratchJr (scratchjr.org). Both of these use a Blockly type of approach to programming, which enables children as young as five to create interactive stories using their iPad or Android tablet with ScratchJr, and older children who can use the PC can visit the Scratch website for more advanced programming. Even adults interested in programming will find the Scratch website useful.

Code is represented as blocks on the screen, and each block performs a simple function like turn left or right, move forward, grow, shrink, say something, loop and so on. The ScratchJr app is great for kids, and you get to choose the background from a library of ready-made ones. You then add characters, and there's a library of those too.

The characters are placed on the screen and can be dragged to the start position. Then programming blocks are dragged to the lower part of the screen and snapped together like jigsaw pieces to create a series of actions that the character is to perform. You can select each character and preview their programmed actions and run the whole scene with all the characters.

The tablet app is best for the youngest children, but once they've mastered it and grown up a bit, they can create more complex programs at the Scratch website. According to the site, 15 million projects have been created and shared, and there are some really clever ones. Projects can be run, then you can switch to the editor to see how they work and to modify them. It's programming made simple.

ScratchJr on the iPad and Android teaches children to program

Aggregate, Delegate, Mixin, and Decorate

Mark Summerfield returns with another helpful tutorial

The traditional approach to object-oriented programming is to use inheritance to model is-a relationships (a Car is-a Vehicle), and aggregation to model has-a relationships (a Car has-a Engine). This article will explain the more modern approach, which is to use aggregation (also called composition) whenever possible, and only use inheritance when necessary. Although Python 3 is used for the examples, the ideas apply equally to Python 2, Java, C#, and C++.

Many classes are specifically designed to be inherited from, and for these inheritance is the right approach. For example, the Python standard library's html.parser module provides an excellent HTMLParser class made to be used in this way. Here's an example of using inheritance:

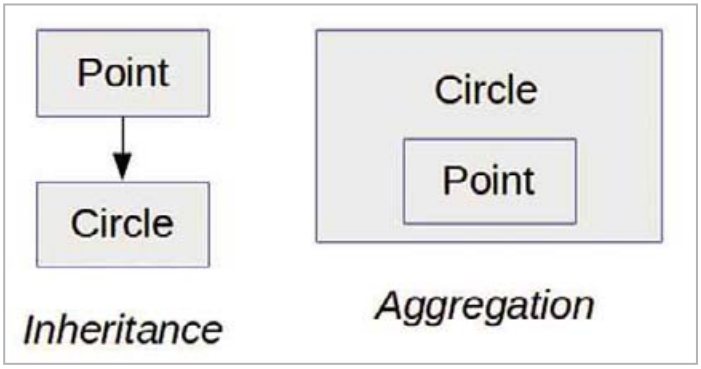
```
class Point:
  def __init__(self, x=0, y=0):
    self.x = x
    self.y = y
  def distance_to_origin(self):
    return math.hypot(self.x, self.y)
  def manhattan_length(self, other):
    return ((math.fabs(self.x - other.x) +
        math.fabs(self.y - other.y)))

class CircleI(Point):
  def __init__(self, x=0, y=0, radius=1):
    super().__init__(x, y)
    self.radius = radius
  def distance_to_origin(self):
    return super().distance_to_origin()
  def edge_to_origin(self):
    return super().distance_to_origin() - self.radius
```

The advantage of using inheritance is that users of our subclass can use all the operators and methods that are defined in the base class. So now, if we write circle = CircleI(3, 5, 2), we can access circle.x and circle.y, as well as circle.radius.

But inheritance can be disadvantageous too. For example, Manhattan length doesn't really make sense for a circle, but we get that method even though we don't want it. Similarly, any methods added to Point at a later date will also be available to CircleI whether they make sense for circles or not. Inheritance can also expose us to the risk of accidentally bypassing validation because we get direct rather than mediated access to inherited attributes. We can eliminate these problems by aggregating rather than inheriting, and delegating access to the aggregated instance's attributes. Here is another circle class, this time using aggregation:

```
class CircleA1:
  def __init__(self, x=0, y=0, radius=1):
    self._point = Point(x, y)
    self.radius = radius
  def distance_to_origin(self):
```




```
    return self._point.distance_to_origin()
  def edge_to_origin(self):
    return self._point.distance_to_origin() - self.radius
  @property # x = circle.x
  def x(self):
    return self._point.x
  @x.setter # circle.x = x
  def x(self, x):
    self._point.x = x
  # omitted y getter and setter
```

Instances of CircleA1 don't have the unwanted manhattan_length() and won't have any other unwanted Point methods that may be added later.

Furthermore, because we have to provide delegates to access the aggregated Point's attributes, we can fully control access – for example, we can add circle-specific constraints. Unfortunately, delegating properties takes several lines of code per attribute, and even method delegates require a one-liner as CircleA1's distance_to_origin() and edge_to_origin() methods illustrate. So aggregation provides control, avoids unwanted features, but at the cost of extra code. Here's an alternative that can scalably handle any number of properties:

```
class CircleA2:
  # __init__() and edge_to_origin() same as CircleA1
  def __getattr__(self, name):
    if name in {"x", "y", "distance_to_origin"}:
      return getattr(self._point, name)
  def __setattr__(self, name, value):
    if name in {"x", "y"}:
      setattr(self._point, name, value)
    else:
      super().__setattr__(name, value)
```

Here, instead of handling each property individually, we delegate accesses to the aggregated point using special methods. Furthermore, we can also delegate methods as we've done here for the Point.distance_to_origin() method. Note that __getattr__() and __setattr__() are not symmetric: __getattr__() is only called when the attribute hasn't been found by other means, so there's no need to call the base class.

Incidentally, it is possible to add methods to a class using a class decorator that eval()s the methods into existence right after the class is created.

Mixins

There is one kind of inheritance which is often used in conjunction with conventional inheritance or with aggregation: mixin inheritance. A mixin is a class which has no data, only methods. For this reason mixin's normally don't have an __init__() and any class that inherits a mixin does not need to use super() to call the mixin's __init__(). In effect, a mixin class provides a means of splitting up the implementation of one class over two or more classes – and allows us to reuse mixins if their functionality makes sense for more than one of our classes. A mixin will often depend on the class that inherits it having particular attributes, and these may need to be added if they aren't already present.

The Python standard library's socketserver module provides a couple of mixin classes to make it easy to create either forking or threading servers.

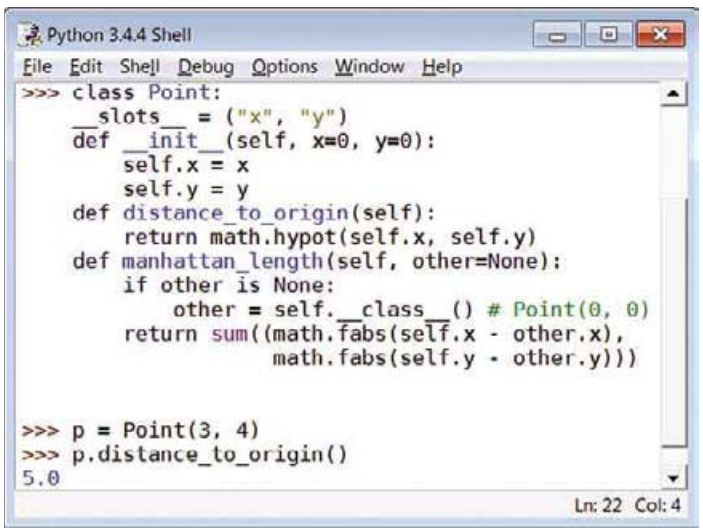
The point and circle classes shown above all have a distance_to_origin() method, which in the case of the circle classes is either inherited or delegated to the aggregated point. An alternative approach is to create a mixin that provides this method and any others that are common to our classes. For example:

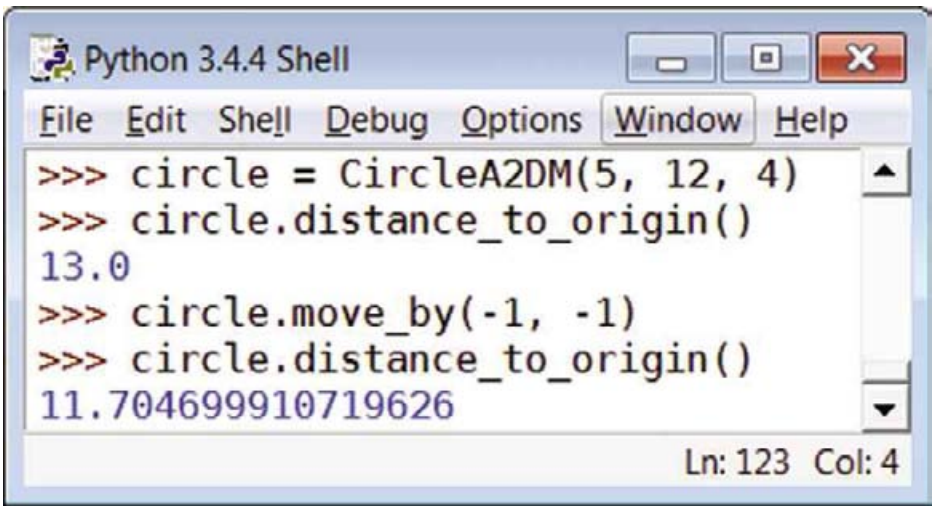
```
class DistanceToMixin:
  def distance_to_origin(self):
    return math.hypot(self.x, self.y)
  def distance_to(self, other):
    return math.hypot(self.x - other.x, self.y - other.y)
class PointD(DistanceToMixin):
  # Same body as Point except no distance_to_origin()
method
```

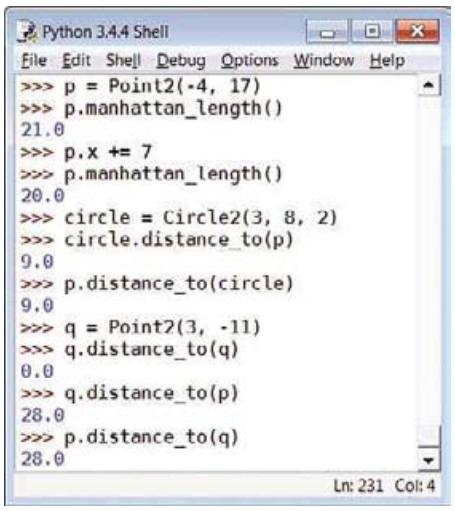
The PointD class gets its distance_to_origin() method and a new distance_to() method from the DistanceToMixin. We can also inherit the mixin in our circle classes, and if we use aggregation there will be no need to provide a distance_to_origin() delegate in CircleA1 or to have "distance_to_origin" in CircleA2's __getattr__() method.

Although Python supports multiple inheritance, this feature is best avoided since it can greatly complicate code and result in subtle bugs (which is why Java doesn't allow it). However, in the case of mixins, because they hold no data, it is safe to multiply inherit as many mixins as we like – and up to one normal class too. For example:

```
class MoveMixin:
  # omitted move_up(), move_down(), move_left()
  def move_right(self, distance):
```








```
    self.x += distance
  def move_by(self, dx, dy):
    self.x += dx
    self.y += dy

class PointDM(DistanceToMixin, MoveMixin):
  # Same body as Point except no distance_to_origin()
method
class CircleA2DM(DistanceToMixin, MoveMixin):
  def __init__(self, x=0, y=0, radius=1):
    self._point = PointDM(x, y)
    self.radius = radius
  # All the rest the same as CircleA2
```

The PointDM class has its own properties (x and y), its own manhattan_length() method, plus all the DistanceToMixin and MoveMixin methods. Similarly, we can create our circle class to inherit the two mixin classes and thereby acquire all their methods, as CircleA2DM illustrates.

Class Decorators

Mixins are probably the best way to add extra methods to two or more classes. However, thanks to Python's dynamic nature, it is possible to create classes and then add extra features (e.g., methods) to them.

Suppose we have some functions like these:

```
def distance_to_origin(self):
  return math.hypot(self.x, self.y)
def move_right(self, distance):
  self.x += distance

# omitted many others
```

They are functions not methods (despite self), because they are declared at the top-level outside of any class. But we can add them as methods to existing classes if we have a suitable class decorator:

```
@add_methods(distance_to_origin, distance_to, move_up,
      move_down, move_left, move_right, move_by)
class Point2:
  # Same body as Point except no distance_to_origin()
method

@add_methods(distance_to_origin, distance_to, move_up,
      move_down, move_left, move_right, move_by)
class Circle2:
  def __init__(self, x=0, y=0, radius=1):
    self._point = Point2(x, y)
    self.radius = radius
  # All the rest the same as CircleA2
```

A class decorator takes a class as its sole argument, and returns a new class – usually the original class with some extra features added.

This updated or new class completely replaces the original.

```
def add_methods(*methods):
  def decorator(Class):
    for method in methods:
      setattr(Class, method.__name__, method)
    return Class
  return decorator
```

The add_methods() function is a function that takes zero or more positional arguments (in this case functions), and returns a class decorator that when applied to a class will add each of the functions as methods to the class.

When Python encounters @add_methods, it calls it as a function with the given arguments. Inside the add_methods() function, we create a new function called decorator() which adds the methods to the Class that is passed to the decorator, and at the end returns the modified class.

Finally, add_methods() returns the decorator() function it has created.

The decorator() function is then called in turn, with the class on the following line (e.g., Point2 or Circle2) as its argument. This class then has the extra methods added to it, after which it replaces the original class.

Python provides rich support for object-oriented programming, making it possible to take full advantage of this paradigm – while also allowing us to program in procedural style (i.e., using plain functions), or any mixture of the two which suits our needs. **mm**

Your Letters

Konrad Zuse

I was so pleased that in this week's Micro Mart you have made acknowledgement of the work of Konrad Zuse in the history of computing. I came across his work on a recent visit to the Deutsches Technik Museum in Berlin, where there is a large exhibition devoted to his work including reconstructions of his computers.

In this country we are justly proud of the work done during WW2 at Bletchley, but we forget that they were not the first to develop programmable computers in the modern sense of the phrase. Maybe because this country is still very anti-German!

There is a good article on Wikipedia about Zuse, but best of all, readers of MM should try to visit the museum in Berlin

David Willey

Gotta Catch Em All

If ever you need evidence that society is falling into an endless pit of stupidity, all you have to do is look at the Pokemon Go craze that's currently taking over the world – not to mention my bloody neighbourhood!

Seriously, the other day, I saw kids I've never seen before, in my garden pointing their phones in random directions. At first, I had no idea what they were doing, but then it clicked.

I was just about to go out there and tell them all to sod off, but then I thought against it. Silly as this whole fad might be, at least it's getting kids off their backsides and out into the fresh air. In fact, Pokémon aside, this could be a positive aspect of all augmented reality apps.

Too often, technology takes over from real life. This way, it becomes one with it. I don't think I'll be catching any Pikachus any time soon, but maybe something will come along that will tempt me off my sofa – which would be just what the doctor ordered!

Jason Braintree

An Uncertain Future

First, thanks for the magazine. It's been very helpful to me these last few years. Since I retired, I've been learning as much as I can about computers and technology. It is all really quite fascinating.

Pleasantries aside, I'm writing to you to talk about the data that big companies keep on us. I can tell you now this is nothing new. Corporations and governments have always kept tabs on us, but what's different now is the sheer detail it goes into and how quickly intelligence can be gathered.

Of course, the Googles and Facebooks of this world are concerned only with making money. Unless you believe we are headed for some dystopian future where governments are owned by businesses, then we probably don't need to worry about them using our information against us.

That said, if a corrupt government were ever to come to power, how difficult would it be to compel internet companies to provide whatever information they might request, in order to tighten their grip?

So in the short term, you might not have anything to worry about if you haven't done anything wrong. In the future, though, things could be very different, and what seems like throwaway information today could be of much greater consequence later, should you ever find yourself fighting against the will of an authoritarian state.

Hopefully, nothing of the sort will ever come to pass in the UK, but it does happen elsewhere, so who really knows what the future might hold?

HJ Cornell

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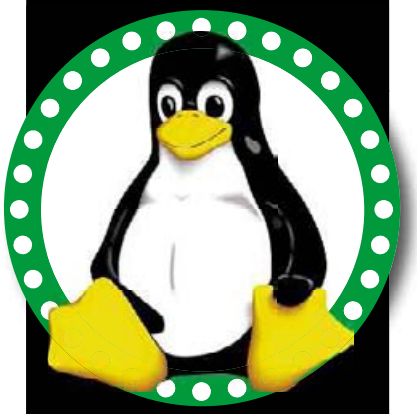

Go Anonymous

Do you know how much you reveal on the internet?

David Hayward has been using Linux since Red Hat 2.0 in schools, businesses and at home, which either makes him very knowledgeable or a glutton for extreme punishment

I was in a proper conspiracy mood last Friday, so much so I spent several hours trawling my usual 'out there' website and conversing with fellow conspiratorial forum members. It was during a rant over the state of the 'secret government' and that the Rockefellers are behind contactless cards (so they and their one-percenters can keep track of your every movement), that I began to consider just how much of this is being viewed.

We all know by now that virtually every conversation we have over the digital airwaves is being intercepted by someone and probably scrutinised to determine whether we're being a little too close to the edge or simply a bunch of harmless loons.

Personally, I use CyberGhost for all my behind-the-scenes looks at the alternate side of the world, but for those who want to be anonymous yet have nothing in place, I'd recommend using JonDonym.

Jon who?

JonDonym is a proxy service that operates in much the same way as the Tor network. It's a cross-platform client that forwards your internet traffic through multiple nodes, providing encryption along the way to ensure your privacy.

This proxy will mask all the internet connections that your various programs will use, faking your location and making it nearly impossible to track your whereabouts on the internet. However, that alone isn't enough for this modern spy-riddled age.

The team behind JonDonym has also added JonDoFox to its arsenal, which is a pre-configured Firefox profile that'll use the JonDonym client while further improving the security and anonymity of your machine through clever use of IP changing and secure, filtered add-ons.

Finally, for an all-out anonymous setup, there's the JonDo and Tor-Secure Live image. This is a Debian-based distro with an XFCE desktop that's pre-configured for use with the JonDonym client and the Tor Onion Router network. There's also Mixmaster Remailer, Thunderbird, Pidgin, TorChat, GIMP and LibreOffice to make it a little more friendly and useable – beyond the anonymity uses.

Free Or Premium

There are two versions of the JonDonym service available: the standard free version and a paid-for premium service.

The free service will offer a maximum connection speed of up to 50Kbps, anonymity on HTTP/HTTPS ports, 2MB download/upload sizes, two country connections and two proxies. The premium service offers unlimited connection speeds, all port security, unlimited upload and downloads, three country IPs and three proxies.

Behind Closed Doors

There's little doubt that browsing or messaging through JonDonym will have you covered. It's cross platform, so you can run the client on Windows, Linux and Mac machines, but the heavyweight is undoubtedly the live image.

If you can, run the live image through another VPN too, for the ultimate in anonymity and privacy.

Until next week, folks.

JonDonym live image, for the ultimate in privacy and anonymity

Put It On My Tab

The next macOS is going tab-happy, but Craig Grannell isn't sure it'll make Macs any more efficient

In macOS Sierra, the next major revision of the Mac's operating system, Apple has extended tabs to any app that enables multiple windows. If the app is well behaved and doesn't do anything particularly funky and weird regarding windows, it'll in this area work much like Safari. This is evidenced in Sierra's public beta, where a New Tab command joins New Window in the File menu. Elsewhere, the Window menu includes options for showing next and previous tabs, moving tabs to a new window and merging all open windows into one.

The idea is for macOS to be more organised and coherent. On small screens, in particular, you can rapidly end up with clutter, windows sprayed across your desktop like an angry person hurling a deck of cards to the floor. When using such a system, it's a wonder you can find anything, and even the Exposé window overview doesn't really help; you just end up staring at a bunch of tiny windows akin to postage stamps, wondering which is the one you actually need.

Yet tabs don't always work either. I quite often sit there during the day, opening new tabs in Safari. I'll check out news articles and press releases, pages about new apps and games, social networks and other time-wasters. By the end of the day, my Mac's almost in meltdown as it seeks to keep a ridiculous number of web pages in memory.

In the past, you at least got a little double-chevron icon (») to denote that there wasn't enough space to show all the tabs, and so you might want to think about dealing with a few of them. Now, the Mac apes iOS in having a scrolling tab bar, making it painfully easy to open approximately 40% of the internet in a single Safari window, and ignore everything but the five or six tab titles that can actually be displayed at any one time.

Annoyingly, the Mac doesn't appear to be keen on assisting you in finding any particular tab. It'll outline what's focused in the current window, but you'll need to hunt through tabs manually to unearth something terribly important that you last saw several hours ago, but that's now behind the Mac equivalent of a user interface labelled 'beware of the leopard'.

Safari at least attempts to get round such issues with a 'Show all tabs' button, which provides a grid of thumbnails to peruse. These are sorted by site, giving you a fighting chance of finding something useful. How other apps intend to deal with the problem of locating content within a mess of tabs remains to be seen.

In a sense, I wish Apple would bring back and enhance tabbed folders. In Finder, you used to be able to drag Finder windows to a screen edge, whereupon they'd appear as a collapsible tab. Third-party app Sticky Windows took the concept further, opening it up to any app, before being brutally squashed by OS X security changes. The reason tabbed folders worked was because they remained in plain sight – they were always ready and waiting to be used, rather than flung to the Mac equivalent of the back of a cupboard.

But Apple rarely returns to the past, and it's obsessed with minimalism, so it's unlikely tabbed folders will make a reappearance. Perhaps Siri is the best hope, and that the next macOS will recognise and intelligently respond to a distressed Mac user, sobbing and frantically trying to find a crucially important document within 11 billion tabs. If not, we'd better hope our pointer fingers and coffee machines are in good working order.

Soon, almost every Mac app will offer the joy/horror of tabs.

Craig Grannell is a writer, designer, occasional musician and permanent loudmouth. He's owned Macs since 1996, when Apple was facing certain doom, and is therefore pleasantly surprised by its current success. Find **Craig** on Twitter at **@craiggrannell**

A Shot In The ARM

Ian McGurren looks at the recent sale of the world's biggest chip designers, ARM

Ian is a professional IT analyst, a semi-professional writer and a pretty amateur electronic musician. He likes gadgetry and loves making gadgets do things they were never designed to do

Mobile

It's not only the UK's biggest technology firms, it's also one of the biggest names in processors worldwide, and the chances are you have several of its products in your home. It's ARM Holdings, and it's just been acquired by Japan's SoftBank for nearly £24 billion.

To some, the name ARM is one that's vaguely familiar, though quite what it does might not be clear. What it doesn't do is make chips, so you can't buy a CPU or GPU fabricated by ARM like you would Intel or AMD. What it does instead is develop designs, which manufacturers then license and produce themselves. What's more, these designs won't always form the full processor; they can instead form the basis which it is built around.

Take, for example, Apple's A-series system-on-chip processors. The latest, the A9X, uses ARM's 64-bit ARMv8-a architecture to form the basis of the chip, and teams it up with a PowerVR GPU and Apple's own design. Others, such as Samsung, have used ARM's microarchitecture to create their own chips. The Exynos 5433 in the Galaxy Note 4 uses the ARMv8-a, but instead of PowerVR, the GPU comes from ARM's own GPU line, 'Mali'.

It's not just smartphones that ARM powers, however. You can find ARM-designed chips in all sorts of devices, including routers, digital TVs, portable consoles, connected home devices, drones and – the next buzzword – smart cities. They're also at the forefront of other smart devices, such as passports, cars, payment systems and so on. It's this enormous breadth of uses that has given ARM Holdings such a vast market value. In a world that's going to only become ever more interconnected, it's chips designed by the likes of ARM that will be in the vast majority of these interconnected devices. In fact, in 2015, more chips with ARM designs in them were shipped than X86-based chips have ever shipped, with 3.5 billion in that year alone.

But why ARM? Why not, say, Intel? Why don't we have Intel chips in the devices we see ARM-designed ones in? One word: heat. Another word: efficiency. Intel's X86 chips were never designed to go in phones or consoles and sip battery power; they were designed to compute and crunch numbers as fast a possible, with power no object, and it's something they do very well, but it's something that produces a very large amount of heat. Any owner of an Intel or AMD CPU will tell you that heat efficiency is king with desktops and laptops. That's not to say Intel hasn't made inroads into mobile computing. The Atom chipset powered the pre-tablet netbook revolution, and refinement of the chip meant we started to see ultra-low power X86 chipsets in mobiles and tablets around 2013. Conversely, there was a version of Windows for ARM, the ill-fated Windows RT, but it suffered from being a locked-down, 'mobile'-ised version of Windows, with very little of the true function of a desktop operating system remaining.

Intel even has its own tiny line, with the Intel Edison, rivalling the ARM-powered (and very popular) Raspberry Pe. Whether the Edison platform will make it into more tiny devices, such as wearables, remains to be seen.

It's an awfully long way from ARM's more humble origins as British home computer pioneer Acorn, and it seems that like its other big name neighbour in the silicon fen, Autonomy (now HP Autonomy), it may no longer be entirely British, though hopefully it will at least stay here and, more importantly, stay competitive.

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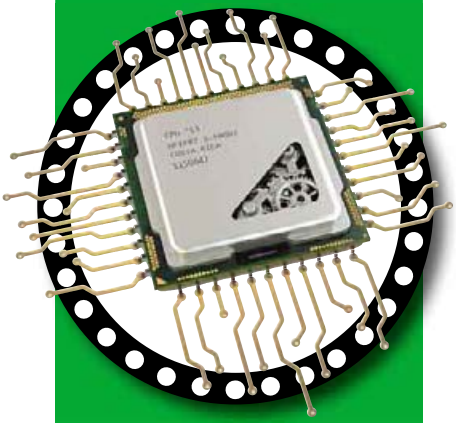

Synology releases an upgrade to its Synology Router Manager operating system

Earlier this year, I had the pleasure of reviewing Synology's first router, the RT1900AC **tinyurl.com/q4hl7we**). It's a great router that provides users with simultaneous dual-band wi-fi, USB 3.0 connectivity for using USB drives as NAS units or for sharing USB printers on the network, four gigabit Ethernet ports and high-speed 802.11ac wi-fi connectivity. That's a decent spec, but it's not unusual for a router at the Synology RT1900AC's price (£120.99, **www.ebuyer.com**). The thing that really distinguishes the RT1900AC from other routers is its built-in operating system, Synology Router Manager (SRM).

SRM is the router equivalent of Synology's excellent DiskStation Manager (DSM) operating system that comes with the company's NAS enclosures. SRM and DSM are accessed remotely over the network, and look, feel and operate like a desktop operating system, albeit one that's focused on a particular use. Users can download add-on programs to expand the functionality of their equipment, such as antivirus software, mail servers and web servers in the case of Synology NAS devices. Apps for the RT1900ac include Download Station, which allows users to search for and download files from a website to attached storage, and media server, which lets DLNA devices access photos, music and video from storage attached to the router. Other apps include a VPN server and DNS server.

I really like the RT1900ac; it has great wi-fi performance, advanced features and a powerful OS that makes it ideal for the layperson and the enthusiast alike. However, it wasn't perfect. For me, there wasn't enough Synology or third-party apps to make use of the RT1900ac's processing power, and there wasn't enough feedback on what it's doing at a particular point in time.

Six months on, and Synology has released SRM 1.1, which should make the RT1900ac even better. New features include Smart WAN, which allows for better load balancing and failover protection for internet connections, Smart Connect, which allows users devices to connect to either the 5GHz or 2.4GHz band depending on which is the most appropriate for the device, and the generation of data traffic reports, among other things.

The RT1900ac has a content filtering feature already, which helps keep vulnerable family members safe on the internet, but SRM 1.1 adds Google SafeSearch integration, as well as the ability to create and use three different content filtering profiles.

These are the headline features, but will SRM 1.1 address the criticisms I made and deliver the features I want to see? I hope so. Either way, SRM 1.1 is an important and worthwhile step in the right direction. It demonstrates Synology's commitment to the RT1900ac and to the continued development of SRM. This is not only good news for owners of the RT1900ac; it also signals to potential consumers that it's worth investing in the RT1900ac.

Andrew Unsworth has been writing about technology for several years, he's handy with a spanner, and his handshaking skills are second to none

Ryan Lambie has loved videogames since he first stared up in awe at a *Galaxian* arcade cabinet in his local chip shop. 28 years on, Ryan writes about gaming for Micro Mart. He's still addicted to chips and still useless at *Galaxian*

Fowl Play

Brink and Dirty Bomb developer Splash Damage has been snapped up by a Chinese poultry factory. It's the latest of some egg-straordinary acquisitions by the firm

This week, Ryan takes a look at the unexpected sale of British shooter developer Splash Damage, and checks out what's coming up in Star Wars Battlefront...

Plug & Play

If the profits in your current business are chicken feed, maybe it's time to get into the games industry. That's exactly what a Chinese company called Leyou Industries has done in recent weeks – noting a downturn in its current guise as a poultry outlet, it's decided to buy up the British developer Splash Damage.

Now, Splash Damage is a studio you might recognise if you're into online shooters. In its early days, it worked on the online modes for such games as *Wolfenstein Enemy Territory* and *Enemy Territory: Quake Wars*, before embarking on such stand-alone titles as *Brink* and the free-to-play *Dirty Bomb*. Thanks to a press release put out by the Hong Kong stock exchange, we now know this British purveyor of competitive shooters is in the ownership of a chicken factory.

According to Leyou, it aims to "diversify its business and mitigate the volatile and cyclical nature of the poultry business" by acquiring videogame companies, since it's spotted that the "videogames industry [has] continued to experience healthy growth despite a slowing world economy."

Leyou's foray into the interactive medium began in 2015 when it acquired a hefty stake (58%) in Digital Extremes, the Canadian team behind the hit online shooter *Warframe* and gothic action title *The Darkness 2*. When that acquisition proved successful (according to website VG247, games accounted for 70% of Leyou's profits), Leyou went off and bought a further 39% of Digital Extremes' business. And now, of course, it's picked up Splash Damage.

Leyou isn't the only Chinese company taking an interest in videogames either. Shenzhen-based holding company Tencent has major stakes in Riot Games, creator of *League Of Legends*, as well as *Supercell*, which brought us *Clash Of Clans,* and *Gears Of War* purveyors Epic. Then there's the Cambridge-based developer Jagex, best known for the hit MMORPG *Runescape*, which was snapped up by Chinese investors in mid-July.

With China now the biggest gaming market in the world, it seems that the industry's garnering interest from all kinds of unexpected places. According to Leyou's statement, the acquisition of Splash Damage "shall not exceed $150m" – that's hardly a poultry sum, we're sure you'll agree.

Online

Star Wars Battlefront didn't exactly receive rapturous reviews when it came out last year, but while even its fans might agree that it isn't the best shooter ever made, it's difficult to argue with the breadth of content EA Dice has been bringing out for it over the past six months. Previous content updates have taken us to the cloud city of Bespin and the murk of Jabba's palace, and added the likes of Lando Calrissian, Nien Nunb and Greedo as playable characters.

The next slab of content for *Battlefront* could prove to be the biggest so far. Scheduled for September, the Death Star expansion will add Chewbacca and the lizard-faced bounty hunter Bossk to its growing line-up of characters. The most exciting aspect of the update will likely be the missions it adds. There'll be on-foot skirmishes among the sleek corridors of the Empire's fully operational battle station and, best of all, the DLC trailer makes strong hints that we'll also be able to take part in the iconic trench run from *A New Hope*.

▲ *"Let's blow this thing and get out of here..." The forthcoming Death Star DLC will bring the Empire's fully operational battle station to Star Wars Battlefront*

The flying aspect of *Battlefront* was never its strongest element, but if EA Dice can tweak the handling of those iconic X-Wings a little, helping the Rebels blow up the Death Star could be an exhilarating mission.

EA has plenty of other stuff planned for *Battlefront* too, including an offline mode – something players have been clamouring for since the game's release. Called Skirmish, the mode will finally let us play the game against bots either in solo campaigns or split-screen with a friend. It's good news for those of us who often find ourselves outgunned by some of the better players online, though a range of difficulty levels means the bots will still provide a challenge if that's what you're looking for.

Looking further ahead, EA also has a fourth and final update planned for the end of the year. It'll be based on the events and characters in the forthcoming *Star Wars: Rogue One*, director Gareth Edwards' spin-off where we'll see how the Rebels managed to steal the plans to the Death Star ahead of *A New Hope*. Jyn Erso (the heroine played by Felicity Jones in the movie) and Krennic (the villain played by Ben Mendelsohn) will be the DLC's additional characters, while the action will take place on the lush, tropical planet Scarif. If you've seen *Rogue One*'s trailers and other footage, you'll have seen the arresting sight of Stormtroopers and Imperial Walkers marching along golden beaches, so we're guessing the *Battlefront* DLC will bring us something similar in its missions.

EA has lots more games based on *Star Wars* in the pipeline, no doubt (we know former *Uncharted* director Amy Hennig is working on one at Visceral, for example), but there'll still be plenty to see and do in *Battlefront* for at least the next six months.

Star Wars Battlefront's Death Star DLC launches in September, while *Rogue One: Scarif* is due out in December.

Incoming

We're rather looking forward to Telltale's forthcoming *Batman* series of adventures – not just because of the studio's form when it comes to making absorbing point-and-click games such as *The Walking Dead* and *Back To The Future*, but because it promises to show us a side of the hero we seldom see in videogames. Telltale has said that the forthcoming season of episodic *Batman* adventures will be as much about Bruce Wayne, the billionaire behind the mask, as his caped alter-ego. Where, say, Rocksteady's *Arkham* games were more about Batman flexing his muscles and tinkering with his gadgets, Telltale's *Batman* will also focus more heavily on detective work and crime solving. Characters already confirmed for the game include Selina Kyle (also known as Catwoman), Harvey Dent (or Two-Face, as his friends call him) and crime boss Carmine Falcone. If the first season of *Batman* is a success, we can expect lots more of the Dark Knight's villains to surface in future instalments.

The first episode of Telltale's *Batman* series launches in mid-August, with a further four episodes scheduled to come out shortly after. **mm**

▲ *Bruce Wayne will be doing some major detective work in Telltale's Batman series. The first of its five-episode season launches in April*

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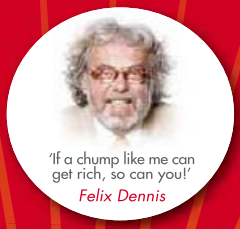

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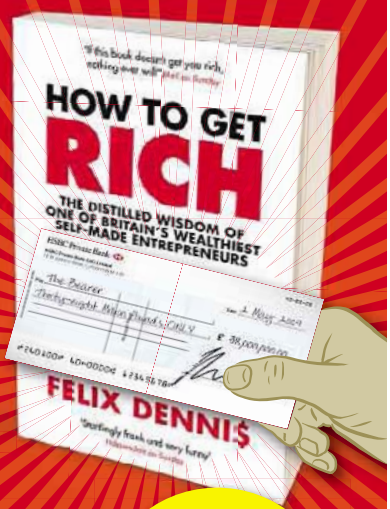

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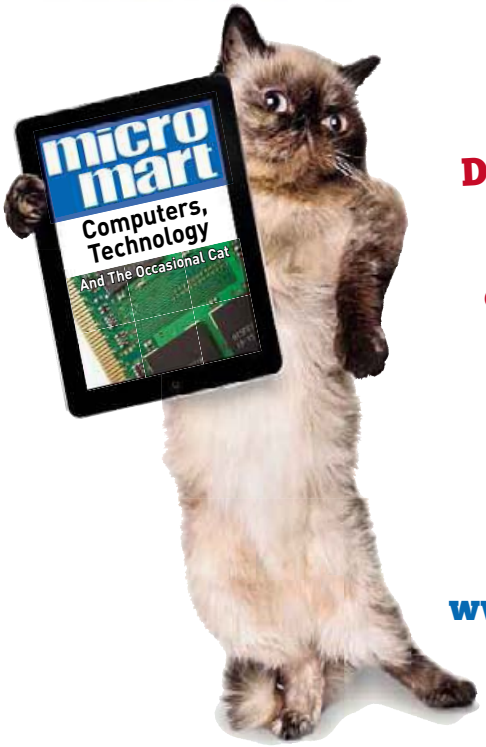

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Aaron

Read-only USB?

I need to copy a large video file to my USB drive for a project. The video file is around 5GB, and I have a 32GB USB stick, so I thought I'd have no problems. When I tried to copy the file, though, I was told the file couldn't be copied.

I tried again and also tried removing the drive and slotting it back in, but this had no effect. So I went out and bought a new USB drive (I needed the file urgently) and came back home with a 64GB model. When I tried to copy the file, the same thing happened.

Both USB drives were new with no files on them, so I'm totally at a loss. As I needed to take the file with me, I had to get a friend to lend me their external hard disk, which worked, but I don't understand why I needed a 500GB external drive to carry a single 5GB video file.

Please explain this so I don't run into the problem again, I'd really appreciate it.

Nev

If you need to move files larger than 4GB, you'll need to format your USB drive to a more recent file system

The answer here is pretty simple, and it's something I really think USB drive manufacturers need to either change or at least explain on their packaging. The problem lies with the file system used by the USB drive. Although it's now very outdated, most USB drives I've seen ship pre-formatted with the old FAT32 file system. Now replaced in most computers with NTFS, FAT32 has a file size limit of 4GB, and files larger than this can't be handled by the file system. NTFS, on the other hand, has a much higher threshold for file sizes, and this is what most people use on their PCs and larger external hard disks, which explains why your friend's volume worked.

This fact is rarely made clear on packaging for drives, and with most still shipping with the older FAT32 system, it can be a problem for many. Luckily, it's easily fixed. Simply plug the drive into your PC and right-click it in Explorer. Select Format and choose the file system option to format to. You can use NTFS, which is used by most or the exFAT option, which should also work. Once this is done, you'll be able to copy larger files to your USB drive.

100% Svc

I've started to notice that my Windows Vista PC occasionally becomes very sluggish for no real reason. At least that's what I thought, until I looked closer into it. I opened up the Task Manager and noticed that I had several entries in the list called svchost.exe, some of which were using a very high percentage of the CPU. I've even noticed 100% use from time to time.

I don't like to randomly end tasks that I don't understand, as I don't know if they're needed by Windows, so I decided to have a quickly look online and found that a lot of people had warnings about possible viruses or attacks using this service. This caused me a lot of concern, so I ran a full virus scan, which found no problems.

I'm really not sure what to do about this CPU usage and these multiple entries. My PC runs fine most of the time, but it still suffers from a lot of slowdowns, sometimes more noticeable after Windows has updated.

Could you please help with this? I'd like to know what this svchost is and if it should even be running on my PC multiple times. Is it a virus that I should be worried about?

Graham

The svchost.exe or Service Host process is often a cause of concern for users, and it's understandable, given its ability to run multiple times and its penchant for using a lot of CPU resources. As you've found, there are known instances of viruses and malware masquerading as this process, but there are also many legitimate entries for this too.

The real svchost.exe is actually a Microsoft process that's part of Windows. It's a process that handles DLL files (Dynamic Link Libraries). A lot of Windows functionality is now executed using DLL files instead of traditional executables (.exe). DLLs can't be run as a normal program, however, so a proxy is needed to actually fire them up, and this is where scvhost.exe comes in. It's simply the delivery program that opens and accesses the required DLL files for Windows. The reason you can have many different svchost processes is because multiple services could be using DLLs and need their own instance of svchost to open the needed DLL. This is normal and isn't necessarily a cause for concern. As each svchost can actually handle multiple DLL items, it's also why each can use such a high portion of your CPU.

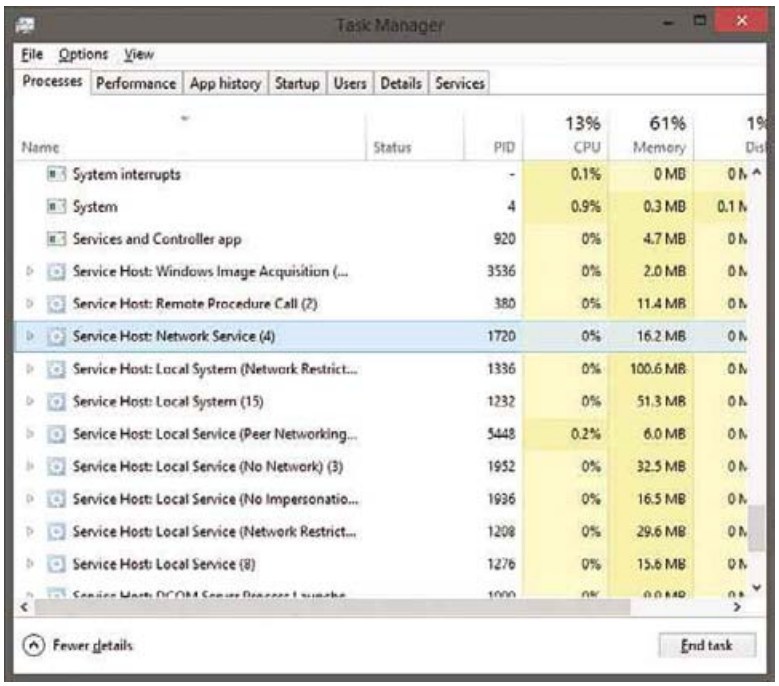
You can manually look into each instance of svchost to see what it's actually doing, which should set your mind at ease. To do this, there are a few methods. First, simply open up Task Manager and locate the svchost entries. Right-click on one of them and select Go To Service(s). This will take you to the list of services on your PC, highlighting the one the svchost is responsible for. If you're using later versions of Windows, such as Windows 8, the entries may actually be called Service Host, followed by the service they're running, so you won't even need to go to services to figure this out; just expand each entry to see the services listed.

Using this information, you'll be able to figure out what's going on and what services are using more resources. With this knowledge, you could decide to stop a service to free up the resources; just be sure to check what the service is responsible for first. You can stop a service by going to the services list and right-clicking it. You can select Stop in the context menu or go to Properties and change settings there.

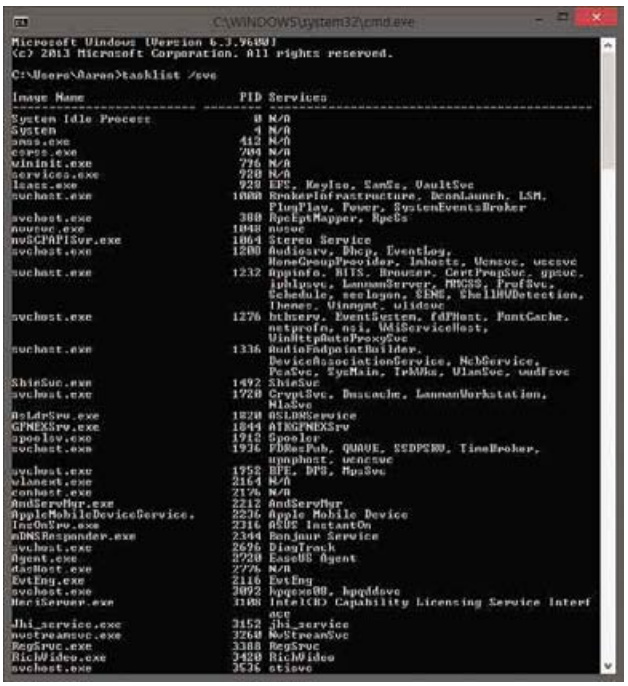
What services you stop will depend on your machine and your configuration, but it's often quite easy to see what kinds of services should remain. For example, you'll want to leave services like Network Service or Local System Services like Windows Firewall.

Another way to check what your svchosts are getting up to is to open a command prompt and type 'tasklist /svc'. This will list the processes in your machine, with the svchosts also listing the various services they're responsible for.

Of course, if you or anyone else having this same problem is still concerned, and you're just not sure what a certain service is, it's always a good idea to research the service online to double-check. I'd also advise using more than a simple virus scanner. Download and use one or two malware scanners too, as these can pick up threats some antivirus apps may miss. As always, it's best to run scanners in Safe Mode to ensure the best possible results.



The Windows Service Host processes are usually normal and nothing to worry about



A simple command line entry can show what's going on

ASK JASON

Meet Jason D'Allison, a veteran of Micro Mart's panel of experts. He's here to help with any technical questions, including anything to do with tablets or smartphones, as well as PCs

Send your questions to:
Jason D'Allison
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30 Cleveland Street
London
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Contact Jason by email at:
jason@micromart.co.uk

While we try to cover as many questions as we can, we regret that Jason cannot answer your questions personally, but he'll cover as many as he possibly can each week. Please ask one question per letter and remember to include the full specification of your computer, including its operating system.

Jason

If You Can't Beat 'Em ... Catch 'Em!

My niece breaks up from school for summer soon, and she's desperate to play Pokémon Go. I don't want her wandering the streets on her own, so as I'm retired I've said I'll take her out a few times a week. I'm too old for all this, of course, but her enthusiasm is infectious! Her phone's a Samsung Galaxy S4 – with a cracked screen, naturally – and mine's a Sony Xperia Z. Are these compatible with the game? It looks as though lots of players are having trouble. I'd like to avoid too much expense if I can!

Bob, Gmail

Niantic, Pokémon Go's chief developer, suggests that the minimum requirements for Android phones are Android 4.4.x (KitKat), an ARM-based CPU (no x86 or MIPS jobs here), and a resolution of 1,280 × 720 ('preferred' but not essential). See* ***goo.gl/fH2hXi****.*

Things are actually a bit stricter than that, however. 2GB of RAM is needed (unless you bypass Google Play and sideload, which I don't recommend), and AR (augmented reality) won't work without a gyroscope. AR allows Pokémon to appear in real locations, as seen through your phone's camera. Without it, the game's playable, but those crazy critters have to live in a drab cartoon world.

Thankfully, though, Bob, you're in for a free ride. The Galaxy S4 and Xperia Z both make the grade. Both aren't far off three-and-a-half years old, yet they're still capable units. Little wonder they're popular second-hand. Many other still-common phones don't fare as well – take the non-4G version of the Galaxy S III (1GB, Android 4.3). Even some brand-new models aren't good to Go – here's looking at you, Wileyfox Spark (1GB, no gyro).

Most of the problems players are experiencing with Pokémon Go aren't related to compatibility, however. They're caused by server overload. The game was always destined to be a smash – the Pokémon franchise has a huge, enthusiastic fan-base – but no one expected a cultural phenomenon. Niantic is steadily upgrading the back-end, but game crashes and login troubles remain regular occurrences, especially in the days after the game's been opened up to new countries (incredibly, as I write, Japan still hasn't been added).

Still, it's all great fun. And it's getting people outdoors. Hatching eggs also requires players to walk 2km, 5km, or 10km – using a car doesn't work. Pokémon Go could well be the world's most successful fitness app. Who'd have thunk it?

It's not just for youngsters and nerds either. Too old? Not a bit of it! A couple of days ago I passed a female pensioner on the hunt for a Krabby – I think, in the end, she bagged a Jigglypuff. It's not uncommon to find a dozen people, adults among them, chatting at a Gym or PokéStop. It's a social game. Of course, there are scare stories – robberies at PokéStops, potential sexual predators, idiots playing from behind the wheel – but common sense, as ever, is the best defence. Sounds as though you've got it sorted, Bob. Happy hunting!

** Apple users need at least an iPhone 5 and iOS 8.x. Windows Phone/Mobile and BlackBerry 10 users can't play.*

Nintendo, co-owner of the Pokémon franchise, has seen its share price double and its market value surge past Sony's

Lost In Translation

After having 'mislaid' a great many important files recently, I've decided to get serious about backups. To that end, I've bought a NAS, fitted with a 4TB spinner. It works, and I'm successfully backing stuff up over wi-fi (or maybe not quite so successfully), but often Windows gives the following alert: 'Are you sure you want to copy this file without its properties?' This happens on all the PCs I'm backing up, across a variety of Windows versions. Exactly what's getting lost?

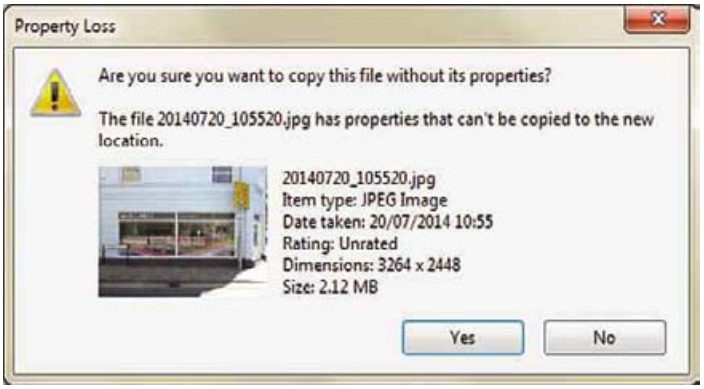
Charles, East Sussex

Don't panic! This has come up before, but not for a good while. Basically, the alert occurs because you're copying files from the NTFS file system to a Linux file system, probably ext3 or ext4. Most NAS boxes run Linux, you see. The alert will mostly happen with media files.

What's getting lost? Not much, Charles. Nothing worth worrying about, anyway. Your meta-data – MP3 tags, camera settings, creation dates, and so on – will remain intact, and the files will open just the same if you copy them back to Windows.

The issue arises because file data under NTFS can be stored in multiple 'streams'. There's usually only a primary stream – the only stream other file systems can recognise – but on occasion Windows programs like to shove stuff into others. I confess I've little idea about what that stuff is, but I do know you'll not miss it.

Move along. Nothing to see here...



Quanta Of Solace

I own a Philips Freevents 15NB57 laptop (Core 2 Duo T5250, 2GB, Windows 7). The CMOS battery's failing and needs to be replaced, but the machine seems rather tricky to open up. I've looked under the screwed-down hatches on the base, exposing the fan and part of the motherboard, but there's no sign of the battery.

I don't have any documentation, and my searches for a disassembly guide on YouTube and elsewhere online have come up empty. I've replaced CMOS batteries on other systems and not had any problems, but I'm a bit stumped here. I really like this laptop, so any help would be appreciated.

Paula Blower, Yahoo!

I've come up almost as empty as you have. Almost. I figured Philips wasn't the manufacturer or even the designer of the 15NB57 and that the laptop was just a rebadged model from one of the Taiwanese or Chinese ODMs – Wistron or Quanta or Foxconn, perhaps. I also reasoned that the same model had probably been sold by companies other than Philips.† And so it's proven. The ODM was Quanta, and the 15NB57 appeared in at least three other guises, most notably as the Advent 5401 (UK) and Aristo Prestige 1800 (Poland).

It's like a treasure hunt. Armed with the information above, the key is to work out Quanta's product code. That'll be on a label somewhere on your Philips' base. One by one, Paula, bang all the numbers into Google – I wouldn't be surprised if you soon track down a manual or video. I can't really help, not without eyeballing those codes.

Worst case, you'll have to feel your way in the dark. I'd say it's a given that the keyboard will need to be removed. Look at the laptop's base again, this time for screws marked with a little keyboard symbol (don't forget the battery compartment and under those hatches). Remove them. If none are marked, remove the lot. Stay organised and remember what goes where!

The keyboard should then unclip around the edges. Be careful, though, as it'll be attached to the motherboard by a ribbon cable. Unplug this. If the keyboard won't budge – perhaps there are no obvious clips – it's probably screwed down. The screws will be hidden under the plastic strip housing the power button, which should prise free. As I say, you may have to experiment – identify the joins in the plastic and try wiggling a blade in them. Use only moderate force; you don't want to snap anything.

*Once the keyboard's out, more of the motherboard should be exposed. If the CMOS battery still isn't visible, the motherboard's protective shroud will have to come off. The screws holding this down should be obvious. The battery probably won't be seated in a surface-mounted holder – the way it would be on a desktop – but will likely be attached via a cable. Just match the plug to items sold on eBay. But if you *still* can't see the battery, I expect the whole motherboard will need to be removed, which may be a step too far, Paula, unless you're feeling brave.*

† ODM = original-design manufacturer. See goo.gl/ZQDM8C.

Finding the CMOS battery on a laptop is often a bit of a treasure hunt

Crowdfunding Corner

Crowdfunding allows you to get your hands on accessories and hardware that might be too niche for a normal production run. It's fair to say that applies to at least one of this week's projects...

Raspberry Shake, The Personal Seismograph

Are you interested in recording earthquakes and other seismic activity? And if not, do you think you could be? Well, the Raspberry Pi has proven super-versatile once again, because now you're able to do just that. All you need is the Raspberry Shake.

This campaign promises to deliver a digital sensor capable of recording earthquakes as small as magnitude 2 within a 50-mile radius, as well as larger ones that happen further afield. Combined with the open and free SWARM software, that means you can create your own personal seismograph. Connect it to your Raspberry Pi, and you can literally watch the earth move.

The campaign already has working models, and you can get your hands on one for just $49 (£37). As well as the Raspberry Shake, you get a personal seismology e-book that can help you understand the field and interpret the data you get. Higher tiers include extra equipment, and if you don't already have a Raspberry Pi, you can pay $299 (£226) for a Raspberry Shake, Raspberry Pi 3, geophone, SD card and case. Everything you need to get started. Units start shipping in November 2016.

URL: kck.st/29XQolM
Funding Ends: Saturday, 20th August 2016

Bycle, The iPhone Bike Mount

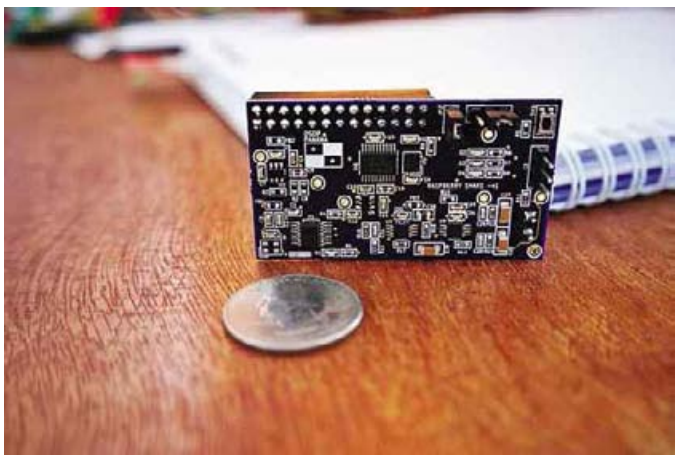
The Bycle is an iPhone mount that attaches to your handlebars so you can use the GPS and video camera functions simultaneously to track and record your journey. If you're looking for a way to turn your bike into a smart bike, it's a premium way to do exactly that.

As well as giving you access to the Bycle app, which allows you to record video, measure distance, calories and speed, travel your journey, navigate through GPS routes and share your rides with others, backing this kickstarter gets you the exclusive Bycle S-Mount. Available in five colours, it incorporates a 'prism lens', so your camera records in front of your bike while your phone screen faces you.

The S-Mount also protects your phone in a study, shock- and water-resistant case, with home and sleep button access and fingerprint unlock. Versions are available for the iPhone 6, 6S, 6+ and 6S+, and you can opt for the E-Mount, which has a built-in 3000mAh battery that can almost triple the usage of an iPhone 6S.

Early tiers have run out, but you can get an S-Mount pay for $55 (£41), which is 21% off the retail price, or an E-Mount pack for $80 (£60) at 27% off retail. The former ships in November and the latter in December this year.

URL: kck.st/2a2xzhs
Funding Ends: Sunday, 14th August 2016



Disclaimer: Images shown may be prototypes and Micro Mart does not formally endorse or guarantee any of the projects listed. Back them at your own risk!

App Of The Week

Pokémon Go

David Hayward: explorer, master Poké-trainer and gym owner

I suppose it was inevitable that at some point I'd have to cover the latest app that everyone in a bit of a flutter: Pokémon Go.

To be brutally honest, I have no idea what the heck is going on with this app. It has me looking around my house, garden and local area for strange creatures that I need to capture, raise and pit against other strange creatures. You can tell I wasn't into Pokémon the first time around, can't you?

Also, I sadly can't tell the difference between a Squirtle and an Electabuzz, other than one of them seems to like hiding behind my compost bin while the other lies in wait on top of my garden shed.

I don't want to come across as a grumpy old codger; I'm all for something that'll get the kids out and about, and it is a bit of harmless fun. Plus the app is using the available technology in such a way that it's easy to see how the future of gaming will take place. Will we one day have Mario Kart Augmented Reality?

I don't care who's watching. I'm catching a Pokémon!

Use the radar to look at what's in your local area

Features At A Glance

- Free app.
- Get's you outside and into some interesting locations.
- Team up and battle other Pokémon trainers.
- Capture rare Pokémon.

What about Doom AR or even a kind of early Ultima AR where you gather your friends together and off you go on a quest to vanquish a dragon that currently lives in the bakery section of your local Morrisons? It's all good fun, and I'm up for that.

Poké-a-what-now?

Augmented Reality specialist Niantic Inc is behind the Pokémon Go phenomena, and in all fairness, the company has done a spectacular job of putting you in the shoes of a Pokémon trainer.

The app uses the phone or device's camera and GPS, giving the illusion that a Pokémon is hiding relatively near to where you're currently located. You simply point in the right direction according to the radar and as you approach the beastie it'll appear, and you can then initiate a Pokébattle, as it's called.

The Pokébattle, in case you're unfamiliar with it, is where you have a Pokéball and you can try to capture the Pokémon in the ball thing. If you're successful, you now own that Pokémon, and from there you can train it, evolve it and go and pit it against other Pokémon trainers or use it in a team to capture a Poké-gym where more training and fighting will increase the Pokémon's endurance and so on.

Over time, you'll amass a well-stocked Pokédex of Pokémon with each evolved to its highest point and combat ready. You'll own a gym or two, and you'll be able to compete with other players who may approach your gyms with the intent to take it over.

Poké-reality

Despite me taking the mickey out of Pokémon Go, it's actually good to see a group of kids walking the streets in search of an elusive Pokémon. There's a kind of 80s vibe about playing with your mates in the open air, even if it is with the aid of a phone. And let's face it, if the technology was around when we were kids, we'd be doing the same too.

Now if you don't mind, I'm off to hunt down that Bulbasaur that's in the neighbour's garden. **mm**

Logging Off

The other day I breezed onto the BBC website to use iPlayer – something I relatively rarely do. When I got to the actual player, I was informed by my browser that the version of Flash Player on my system was 'unsafe', and I should upgrade it immediately.

Now, really what it should tell you to do is uninstall Flash and never let it near any of your computers ever again. That would be singularly better advice, surely?

When you think about it, the system was suggesting that I upgrade from version 21 to the new 22nd release. Previously we've seen 21 versions of Flash that are all considered 'unsafe' now for numerous reasons, but they were considered perfectly harmless when they were first released.

Based on that track record, the possibility that version 22 isn't safe isn't much of a leap, but closer to a practical guarantee from a statistical viewpoint.

So wouldn't it be more honest to say 'Here's a new version, and we're confident that it is 'unsafe' too but in a way that we're unaware of as yet but that will inevitably become revealed by the passage of time'.

I haven't seen any software companies say that yet, though we've all thought that at some point or another. A variation on that theme would be the idea that the current version of a product is 'the best yet'. As most companies, with a few exceptions, don't start out with the intention of making something worse than their previous efforts, surely that's a given?

That notion has been floated through Windows' launches; it's almost a trope. Let me guess, this is the best version of Windows yet? And it's the most secure? And it includes all the things I wanted, even if I wasn't consciously aware of wanting them, and it takes out all the things I utterly hated about the last one. Miss anything?

How many times has that actually been true, in part or totality? Or would a better question be how many times has it been patently untrue?

Not wishing to go down the well-worn path of the versions of Windows that are agreed to be pants, let me take this idea outside computers altogether. Have you ever watched

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a documentary about the cars or planes made by a specific company where they hark back to classic designs of the past and declare them the best Ferrari, Lamborghini Tractor or whatever? They might throw in their very latest design, but they don't normally conclude it is the best, do they?

No, because it is almost impossible to access something when it first appears subjectively, so calling it the best seems ludicrous until much, much later.

Why the world of computing thinks that these practicalities don't apply to it I've no idea, but it does hint at a lack of honesty if we're being candid.

I entirely fail to see how saying things you know to be openly untrue enhances the value of what they're saying rather than degrades it.

Whatever anyone else says, including the BBC, Flash isn't safe, and suggesting it is by getting the latest version is exactly the sort of misinformation that we really need to filter. But don't take my word for it, obviously.

Mark Pickavance

LAST WEEK'S CROSSWORD

Across: **7** Clive Sinclair, **8** Ballot, **9** Oldies, **10** Gamepad, **12** Triad, **14** Happy, **16** Bolivia, **19** Domain, **20** Dealer, **22** Hundredweight.

Down: **1** Plea, **2** Evolve, **3** Ashtray, **4** Snoop, **5** Slider, **6** Literati, **11** Analogue, **13** Lowdown, **15** Pravda, **17** Italic, **18** Index, **21** Echo.

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Prior to the writing of this part of the magazine, we've been killing time by lying in the almost endless sunshine we've had most recently. Yes the sun has opted to actually shine on us, and nothing seems to be stopping it. Good stuff, we say, Mr Sun. Yes, outside has been drenched in sun. Great as that is, the MM team, of course, spends a huge chunk of time each week indoors, working to get this magazine out. But although that's true, we're okay. Crying about it wouldn't really do any good anyway, would it? Not that that's ever stopped us. We could go outside for a bit and have our lunch in a park. Mmm... Eating there could be good, but it means having to walk there. Actually, come to think of it, just leaving the office is a chore, and lounging around isn't really fun. Playing the latest instalment in the Fallout series is fun. That's killing time in style, we say. For all the good the sun gives us, it's completely useless at running heavily demanding games. It's useful, yes, but why go outside? Augment reality games maybe?

THIS WEEK'S CROSSWORD

Across

7 The supposed principle that future events are likely to turn out so that they balance any past deviation from a presumed mean. (3,2,8)

8 Something that baffles understanding and cannot be explained. (6)

9 Compel a person or group to conform to a procedure or protocol - possibly without prior consultation or agreement. (6)

10 Use deception to deprive someone of money or possessions. (7)

12 Try before you buy software. (5)

14 A punctuation mark (/) used to separate related items of information. (5)

16 A series of American space probes launched between 1958 and 1973, two of which provided the first clear pictures of Jupiter and Saturn. (7)

19 .ca TLD. (6)

20 A musical term in Italian, meaning from the beginning. (2,4)

22 The new name for the Linux KDE office package. (8,5)

Down

1 Also known as channel bonding, it's a cluster of nodes connected in a computer network topology with multiple interfaces and redundant storage. (Acronym) (4)

2 In Greek mythology any of three sisters, Stheno, Euryale, and Medusa, with snakes for hair, who had the power to turn anyone who looked at them to stone. (6)

3 A simple story used to illustrate a moral or spiritual lesson. (7)

4 The default text editor for the Linux GNOME desktop environment. (5)

5 PC backup software packages from Future Systems Solutions. (6)

6 Credited with originally developing JavaScript for client-side scripting of web pages. (8)

11 Casually or irresponsibly withdraw from a situation in which one is involved or for which one is responsible. (4,4)

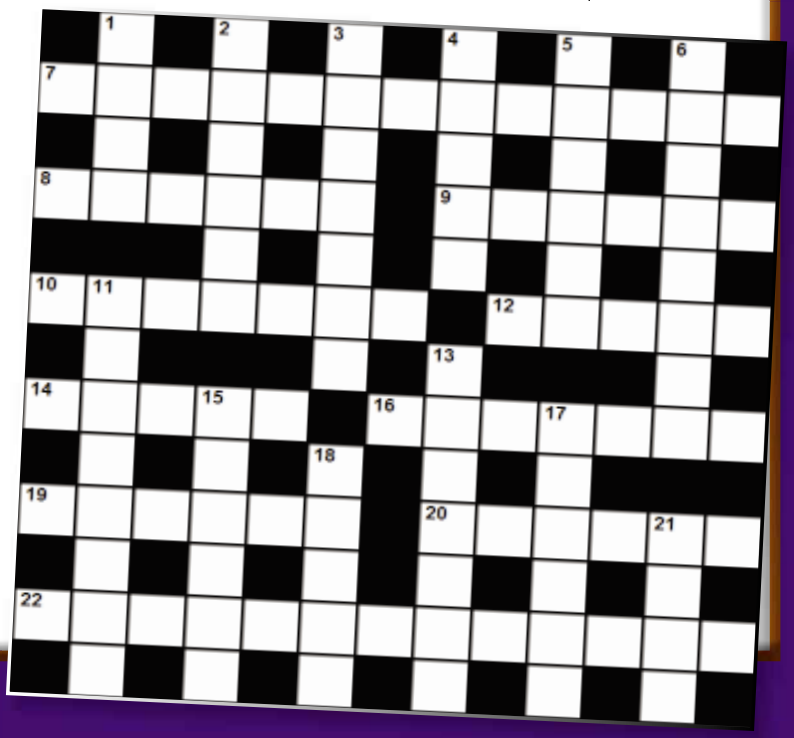
13 The sailor hero of one of the tales in the Arabian Nights, who relates the fantastic adventures he has during his voyages. (7)

15 Not liable to undergo chemical decomposition, radioactive decay or other physical change. (6)

17 Austrian computer hardware manufacturer of CPU coolers and computer fans for primarily the enthusiast market. (6)

18 The distance between a camera and the subject to be photographed. (5)

21 The access route to a file or folder, showing the drive and all of the folders and subfolders in sequence. (4)



In Next Week's Micro Mart*

- What's new in Bluetooth 5, and when can you expect to see it?
- How to delete data from a hard drive forever
- Why computers struggle with random numbers
- Plus the usual mix of news, features, reviews and advice

* May be subject to change

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